Engineering Library

DEC 8 1927

"THE ENGINEER," NOVEMBER 25, 1927.

With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CXLIV.—No. 3750] LONDON: FRIDAY EVENING, NOVEMBER 25, 1927 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 9th December, 1927, for EXTENSION and ALTERATION of LOW-PRESSURE HOT WATER HEATING at the Sorting Office, East Croydon.

Drawings, specification and a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. OFFICE OF WORKS, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 7096

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for—

1. THREE SPANS of 76ft.
2. HAND POWER TRAVELLING CRANES, 5ft. 6in. gauge—Ten of 5 tons and Sixteen of 15 tons.
3. TEN SLUICE GATES.

Tenders due on the 13th December, 1927, for Nos. 1 and 2, and on the 21st December, 1927, for No. 3.

Forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 7101

Engineering Draughtsman REQUIRED by the GOVERNMENT of TANGANYIKA TERRITORY for the PUBLIC WORKS DEPARTMENT, for a tour of 20 to 30 months' service, with possible extension. Salary £372, rising to £480 by annual increments of £18. An outfit allowance of £30 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 23 to 35, preferably unmarried, must have had some years' experience with a firm of civil engineers and be experienced in Plotting Surveys and in the Preparation of Designs for Bridges, Waterworks, &c., and be competent to Take Out Simple Quantities.—Apply at once by letter, stating age, experience and qualifications to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/308. 7102

University of London. A COURSE of FOUR LECTURES on "THE VENTILATION OF MINES" (considered from the engineering standpoint) will be given (with lantern illustrations) by Prof. HENRY BRIGGS, O.B.E., D.Sc., Ph.D., A.R.S.M., Hood Professor of Mining in the University of Edinburgh, at the IMPERIAL COLLEGE, ROYAL SCHOOL OF MINES (Prince Consort-road, South Kensington, S.W. 7), on DECEMBER 5th, 6th, 7th, and 8th, at 5.30 p.m. At the first Lecture the chair will be taken by Henry Walker, Esq., C.B.E., Chief Inspector of Mines.

ADMISSION FREE, WITHOUT TICKET.

EDWIN DELLER, Academic Registrar.

7029

Armourers and Brasiers' COMPANY.

LECTURES IN METALLURGY.

The Company have arranged for the following Lectures to be delivered :—

At the Royal School of Mines, Prince Consort-road, South Kensington, at 5.15 p.m., on the 8th, 15th, and 22nd November, 1927, by G. Shearer, Esq., M.A., D.Sc., on "X-RAYS AND METALS."

At the Chelsea Polytechnic, Manresa-road, S.W., at 8 p.m., on the 30th November, 7th and 14th December, 1927, by Professor Cecil H. Desch, D.Sc., Ph.D., F.R.S., F.I.C., on "THE DEFORMATION OF METALS."

Admission free, without ticket. 6816

The Manchester Steam Users' ASSOCIATION.

Mr. C. E. Stromeyer is retiring from the position of CHIEF ENGINEER next March after 30 years' service, and the Executive Committee invite APPLICATIONS to fill the VACANCY.

Only those possessing the highest qualifications and capable, by education and training, of conducting the whole of the Association's affairs, should apply.

Applications, stating age and giving full particulars of career and references (not testimonials), should be addressed to the EXECUTIVE COMMITTEE of the ASSOCIATION, 9, Mount-street, Albert-square, Manchester, by December 6th. 7018

Ashborne Urban District COUNCIL.

RODSLEY WATER SCHEME.—CONTRACT NO. 7. PUMPING STATION BUILDING.

The Council invite TENDERS for the CONSTRUCTION of a HIGH-CLASS PUMPING STATION BUILDING on their property at Rodsley, near Ashborne, Derbyshire.

The contract will include Concrete Foundations and Brick Superstructure with Reinforced Concrete Roof, &c. Foundations or Machinery, Roadmaking and Drainage Work are also included in this contract.

Copies of the specification and form of Tender prepared by the Engineer, Dr. Herbert Lapworth, M. Inst. C.E., 23, Victoria-street, Westminster, may be obtained on application to the Clerk to the Council on or after Monday, 21st November. The application must be accompanied by the sum of £3, which will be refunded on return of the documents within seven days, or after receipt of a bona fide Tender and the documents required.

Tenders are to be sent in on the form supplied, and with the specification must be enclosed in a sealed cover endorsed "Rodsley Water Scheme: Tender for Pumping Station Building: Contract No. 7," addressed to and reaching the Clerk to the Council not later than 10 a.m. on Monday, December 12th.

Facilities for examining the drawings, for inspecting the site and general information may be obtained on application to Mr. D. Powell, M. Inst. M. and Cy. E., Surveyor to the Council, Council Offices, Ashborne, Derbyshire.

It is particularly requested that none but experienced engineering contractors shall apply.

The Council do not bind themselves to accept the lowest or any Tender.

R. WILLIAMS, Clerk to the Council.

Council Offices, Ashborne, Derbyshire. 7070

The Engineer

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PUBLIC NOTICES

The Institution of Structural ENGINEERS.
EXAMINATIONS FOR GRADUATESHIP AND ASSOCIATE MEMBERSHIP.

The next Examinations for Graduateship and Associate Membership will take place in London and such other centres as may be arranged on Wednesday, 7th December (G), Thursday and Friday (A/M). Syllabus and form of entry from the undersigned.

MAURICE G. KIDDY, F.I.S.A., Secretary.

10, Upper Belgrave-street, S.W. 1. 7071

Manchester Corporation.

The Rivers Committee invite TENDERS for the CONSTRUCTION of MOSS SIDE and WHALLEY RANGE DRAINAGE NEW RELIEF SEWERS, Brantingham-road, Stamford-road and Platt-lane, between Manchester-road and Upper Lloyd-street; and in Wood-road and College-road, between Upper Chorlton-road and Victoria-road.

Plans may be seen and specifications, bills of quantities and forms of Tender obtained on application at the City Engineer's Office, Town Hall, Manchester, on payment to the City Treasurer of £5 5s., which sum will, after the Corporation have come to a decision upon the Tenders received, but not before, be returned to the person submitting a bona fide Tender.

All cheques or postal orders are to be made payable to the order of "The Corporation of Manchester."

Tenders, enclosed in the official envelope and addressed to the Chairman of the Rivers Committee, are to be delivered at the City Engineer's Office not later than 9.30 a.m. on Wednesday, the 7th December, 1927.

The Corporation do not bind themselves to accept the lowest or any Tender.

P. M. HEATH, Town Clerk.

Town Hall, Manchester, 10th November, 1927. 7013

The Mond Nickel Company, Limited, invite APPLICATIONS for POSITION of JUNIOR RESEARCH METALLURGIST. Salary according to qualifications, but not less than £200 per annum.

Apply by letter, stating age and qualifications, to the SECRETARY, Research and Development Department, The Mond Nickel Co., Ltd., Victoria Station House, London, S.W. 1. 7076

PUBLIC NOTICES

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—

(1) 204 TONS STRUCTURAL STEEL WORK for ENGINE SHED (together with Corrugated Asbestos Sheets, Patent Glazing with Wired Glass, Galvd. C.I. Piping and Fencing Pales, &c. &c.).

(2) 9 PETROL TANK WAGONS, 4-WHEELED, I.R.C.A. Standard Type, K.1, complete with WHEELS and AXLES (BROAD GAUGE).

Tenders are due in as follows :—

(1) by Thursday, 15th December, 1927, at 10.30 a.m.

(2) by Tuesday, 13th December, at 2 p.m.

Tender forms obtainable at above address; fee One Guinea each, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 7085

Metropolitan Borough of SHOREDITCH.
JOINT APPOINTMENT OF RESIDENT ENGINEER AND ASSISTANT SUPERINTENDENT, AND MATRON.

APPLICATIONS are INVITED for the above APPOINTMENT at the Haggerston Public Baths, Mansfield-street, E. 2. Wife to act as Matron. The Engineer must hold the 1st Class Engineer's B.O.T. Certificate, and both must have had previous public baths experience.

The age of applicants must not exceed 45 years.

The appointment is subject to the provisions of the Shoreditch, &c. (Superannuation) Act, 1922, and the salary attached thereto has been allocated as follows :

Resident Engineer and Assistant Superintendent, £240 per annum rising by annual increments of £15 to a maximum of £300 per annum.

Matron, £80 per annum, rising by annual increments of £5 to a maximum of £100 per annum, with rooms, lighting and heating.

Applications, on the form supplied, endorsed "Appointment of Resident Engineer," must be received at this office addressed to the undersigned, not later than Noon on Friday, 9th December, 1927.

Canvassing, directly or indirectly, will be a disqualification.

J. A. D. MILNE, Town Clerk.

Town Clerk's Offices, Shoreditch Town Hall, Old-street, E.C. 1, 18th November, 1927. 7098

PUBLIC NOTICES

Municipality of George Town, PENANG, STRAITS SETTLEMENTS.
MUNICIPAL ENGINEER'S DEPARTMENT.
APPOINTMENT OF ASSISTANT ENGINEER.
ADVERTISEMENT.

The Municipal Commissioners of George Town, Penang, REQUIRE an ASSISTANT ENGINEER, aged 23 to 30 years, unmarried, on a three years' agreement, with probable extension.

Applicants must have had a good technical education and regular training as pupil and assistant, preferably in a Municipal or County Engineer's office, and must possess experience in Municipal and General Engineering, Roads, Buildings, Bridges, Sewerage and Conservancy Work, and the control of workmen.

Candidates must either have passed the Associate Membership examination of the Institution of Civil Engineers or must hold the Testamur of the Institution of Municipal and County Engineers.

Salary 4800 dollars to 5400 dollars for the first year, according to qualifications, and rising by annual increments of 300 dollars in the second and third years of the agreement. In the event of the appointment being continued after the expiry of the agreement, the salary will rise in accordance with the Municipal Commissioners' Salary Scheme.

Salary will be paid monthly, in dollars, the currency of the Colony, the value of the dollar being 2s. 4d. sterling. In addition, there is at present a temporary allowance of 10 per cent. on the salary for unmarried men. The pay of the appointment at the above rate for the first year, including the temporary allowance, would be £616-£693. An allowance for the maintenance of a motor car when on duty will be granted. Free passage will be provided, with half-pay during the voyage out. The selected candidate must pass an approved medical examination. Eight months' leave, on full pay, with passage paid, is usually granted after four years' service, if the appointment be continued for that period.

There is a compulsory Superannuation and Provident Fund for Municipal Servants, of which the person appointed must become a member. Its chief points are as follows :—Members contribute 10 per cent. of their salaries, and the Commissioners make a donation of a similar sum. After ten years' approved service, or at death, or (with certain conditions) on forced retirement at any time, the amount standing to an officer's account (contributor's subscription and Commissioners' donations with accrued interest) is paid to him or his representatives, as the case may be.

Penang is one of the beauty spots of the Eastern World; George Town is situated on the coast, within three miles of the Penang Hills Railway, running up to the Hill Station 2400ft. above sea level. There are excellent facilities for swimming, riding, golf, tennis, cricket and all other games. The population of George Town is 134,000, and the day temperature about 80-90 deg. Fah.

Applications, stating whether married or single, age, birthplace, and giving details of education, training and experience generally, with particular reference to the qualifications mentioned above, and accompanied by copies (not originals) of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents for the Commissioners, not later than Wednesday, the 7th December, 1927.

Further particulars, if desired, can be obtained from the Agents. 7079

South Staffordshire Water-WORKS COMPANY.
CIVIL ENGINEERING DEPARTMENT.

APPLICATIONS are INVITED for the APPOINTMENT of SECOND CIVIL ENGINEERING ASSISTANT. Age 26-35 years.

Candidates must have had considerable experience in the design and maintenance of important waterworks, including impounding reservoirs, large pumping units, reinforced concrete service reservoirs, detection of waste and the distribution of water throughout large areas of supply.

Applicants must be corporate members of the Institution of Civil Engineers, having had responsible experience with a water company or Water Department of a Public Authority.

Ex-Service men will receive preferential consideration.

Commencing salary £450 per annum, which is subject to deductions under the Company's Superannuation Scheme.

Applications, stating age, details of education, training, qualifications and particulars of experience accompanied by copies (only) of three recent testimonials, endorsed "Civil Engineering Assistant," must be addressed and delivered to the undersigned not later than the 17th December, 1927.

FRED. J. DIXON, M. Inst. C.E., Engineer-in-Chief.

22nd November, 1927. Engineer's Office, 29a, Paradise-street, Birmingham. 7074

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PUBLIC NOTICES

North Riding of Yorkshire
COUNTY COUNCIL.
HIGHWAYS AND BRIDGES COMMITTEE.
APPOINTMENT OF DIVISIONAL SURVEYOR.

APPLICATIONS are INVITED from duly qualified persons for the APPOINTMENT of DIVISIONAL SURVEYOR to take charge of a Division of Roads and Bridges under the County Surveyor.

Applicants must not be more than 35 years of age and must be prepared to pass a medical examination. The salary will be £300 per annum, rising by £15 per annum to £360, together with travelling allowance, subject to revision, but which at present is £320 per annum. The successful candidate will be required to provide and maintain a suitable motor car.

The office is an established post for the purpose of the Superannuation Act, 1922, and a deduction of 5 per cent. will be made from the salary.

Applications on the forms to be obtained from the undersigned are to be delivered not later than 3rd December, 1927, addressed to "The County Surveyor, County Hall, Northallerton," endorsed "Divisional Surveyor."

HUBERT G. THORNLEY,
Clerk of the County Council.

County Hall, Northallerton,
16th November, 1927. 7058

Western Australia.

An experienced LOCOMOTIVE DRAUGHTSMAN is REQUIRED by the Western Australian Government Railways.

Applicants must be fully qualified Locomotive Draughtsmen, with workshops practice and actual experience in the designing of the latest types of locomotives.

Age not to exceed 35 years.

Commencing salary £398 per annum, rising to £428 by two annual increments of £15.

The appointment, which will be for a period of three years, subject to renewal by mutual arrangement, is also subject to the Rules and Regulations and Salaried Staff By-law of the Western Australian Government Railways and the conditions and privileges of the Railway Salaried Officers' Award.

The successful applicant will require to take up duties at Midland Junction, Western Australia, within four months from date of selection.

Second-class fare by mail steamer will be allowed to Western Australia and half-pay on voyage from date of sailing until arrival in Western Australia.

Written applications, accompanied by medical certificate, testimonials and certificate or statutory declaration as to date of birth and nationality, setting forth concisely the technical qualifications, general education, age, and experience of applicant, stating also whether married or single, will be received by the

AGENT-GENERAL FOR WESTERN AUSTRALIA,
Savoy House,
115/116, Strand, London, W.C. 2,

up to the 31st December, 1927. Applications should be marked "Locomotive Draughtsman." 7050

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED by Engineering Firm of Standing, a Very Smart MAN as REPRESENTATIVE. Must be good Engineer and well up in Mechanical Handling Problems, Conveyors, Elevators, &c.—Address, giving age, qualifications and salary expected, 7032, The Engineer Office. 7032 A

WANTED, ENGINEER, to Assist Agent on Public Works abroad. State age and experience. Preference given for experience in Earth Dams. Only fully qualified men need apply.—Address, 7087, The Engineer Office. 7087 A

WANTED, Good True-to-Scale or Collotype PRINTER, reliable and trustworthy. Age, experience, credentials, salary.—Address, P3930, The Engineer Office. P3930 A

WANTED for Old-established Firm, a Good MECHANICAL ENGINEER, preferably with some electrical knowledge, excellent at design, and the direction of works; must have technical ability, tact, and be prepared for hard work.—Apply by letter only in first instance, to "X." 2611, Harrison's, 46, St. Martin's-lane, London, W.C. 2. 7066 A

APPLICATIONS are INVITED for the POSITION of ENGINEERING ASSISTANT to the Managing Director of a North of England Firm. Experience in the design of Structures and Mechanical Handling Plant is essential, while a knowledge of Coal Washery and Screening Plant design will carry considerable weight.

Applications will only be considered from first-class men, and should give details of age, experience, and salary required.

Address, 7083, The Engineer Office. 7083 A

ASSISTANT SUB-EDITOR for Staff of Technical Papers. Good literary, engineering and general knowledge essential. State age and salary and enclose specimens of work.—Address, P3918, The Engineer Office. P3918 A

BLAST-FURNACES.—WANTED, ASSISTANT to MANAGER. Young man with good engineering training preferred.—Address, giving full details and salary required, 6989, The Engineer Office. 6989 A

COSTS ACCOUNTANT WANTED.—An Organisation of considerable magnitude with a number of engineering and kindred works have VACANCY for a really experienced ACCOUNTANT practised in research and the production of costs for the guidance of their management; one with sound experience in accountancy as well as pure cost production will be given preference. Reply in confidence, giving full details of past record, stating age and salary expected. A remuneration suitable to the record of applicant will be arranged. Hand-written replies will be appreciated.—Address, 7065, The Engineer Office. 7065 A

CIVIL ENGINEER for Important Company in NEAR EAST. Member of Institute, and Public School preferred. Age 23-27, single. Salary to commence, £500 plus benefits.

CALL C. W. PETTY AND COMPANY (APPOINTMENT SPECIALISTS), 58, HAYMARKET, S.W.1. 'PHONE, GERRARD 3412-3. P3931 A

FOR GLASGOW and WEST OF SCOTLAND.—REQUIRED by well-known Manufacturing Firm, ONE or TWO really capable REPRESENTATIVES calling on electrical engineers, collieries, large works and garages, to sell advertisers' goods as additional lines on liberal commission terms. No samples to carry. Interviews arranged in Glasgow on 5th or 6th December.—Address, giving full particulars, experience and lines carried, 7089, The Engineer Office. 7089 A

GENERAL WORKS MANAGER.—WANTED, an up-to-date GENERAL WORKS MANAGER, age about 30 to 40, experienced in latest shop practice in Structural Work, Tank Construction, Oil and Gas Installations, and General Engineering and Foundry Practice. No application except from those with the above experience will be considered.—Apply, with two copies of recent testimonials or names of referees, and stating salary required, to the SECRETARY, Whessoe Foundry and Engineering Co., Ltd., Darlington. 7080 A

POWER STATION ENGINEER WANTED AT ONCE to Superintend Contracts and Erection for Extension of Private Power-house. Good experience with boiler plant and turbines essential. Electrical qualifications not important.—Address, stating age, experience, and salary required, 7084, The Engineer Office. 7084 A

REQUIRED, Thoroughly Experienced STEEL WORK ERECTOR, competent to set out and accurately erect Steel-framed Structures, &c.; must be good organiser, take control men, and run a number of jobs simultaneously. Reply in confidence, stating age, experience, and salary required.—Address, P3920, The Engineer Office. P3920 A

WORKS MANAGER WANTED for Large Wheel and Axle Works. Apply by letter, stating experience and salary expected.—Address, P3914, The Engineer Office. P3914 A

WANTED, First-class DRAUGHTSMAN, with Good experience in the design of Hydraulic Presses, Pumps, and Accumulators. A knowledge of Oil Presses is desirable, but not essential. Applications treated confidentially.—Address, "CONFIDENTIAL," Tangyes Limited, Cornwall Works, Birmingham. 7094 A

WANTED IMMEDIATELY, for Manchester District, MACHINE TOOL DRAUGHTSMAN, with some years' experience.—Address, giving all particulars, 7069, The Engineer Office. 7069 A

WANTED, JUNIOR DRAUGHTSMAN on Engineering Work in country district, 24 miles from London; used to Refrigeration and/or Marine Auxiliaries.—Address, P3939, The Engineer Office. P3939 A

A SMALL FIRM of GENERAL ENGINEERS in the Midlands, with a wide range of Mechanical and Structural Manufactures, REQUIRE a first-class DRAUGHTSMAN to Take Charge of Drawing-office.

Applications are invited ONLY from men who can adduce evidence of previous satisfactory experience in charge upon:—

Gasworks or Colliery Plant,
Winches, Haulage Gears,
Engines, Pumps, Fans,
Receivers, Tanks, and
General Constructional Work, or some of the above lines.

Replies will be treated confidentially and should furnish full particulars of age, experience, previous employers, salary required, and when at liberty. Applications in other form cannot be considered.

Address, 7090, The Engineer Office. 7090 A

DETAILING DRAUGHTSMAN REQUIRED for Constructional Steel Works in North London. Must be able to prepare shop drawings with the minimum supervision and be familiar with Steel Frame (1909 Act) Buildings.—Address, stating age, experience and salary required, P3912, The Engineer Office. P3912 A

DRAUGHTSMEN REQUIRED for London Works; must be experienced and preference would be given to men used to Printing Press work.—Address, stating particulars and salary required, 7048, The Engineer Office. 7048 A

DRAUGHTSMAN REQUIRED, Thoroughly Experienced in design and construction of Petrol and Paraffin Engines, marine and stationary. Reference and salary in confidence.—Address, 7072, The Engineer Office. 7072 A

DRAUGHTSMAN REQUIRED, Used to Light Structural Steel Work Design.—Only those with previous experience need apply to C. and S. CONSTRUCTION CO., stating age, experience, and salary required, Bridgeway House, Bridge-road, W. 6. 7092 A

DRAUGHTSMAN WANTED, Experienced in Turbine and Engine Work. State experience, age, and salary, also when free.—Address, 7086, The Engineer Office. 7086 A

LADY TRACER WANTED in London Engineer's Office. Must be quick and neat. State experience and salary required.—Address, 7091, The Engineer Office. 7091 A

REFRIGERATION DRAUGHTSMAN WANTED for London area, with good Refrigerating Experience; able to put orders through clearly. Must be keen on reducing production costs and capable of designing up-to-date tools and jigs.—Write, stating age, experience and salary required, Box 668, Sells' Advertising Offices, Fleet-street, E.C. 4. 7100 A

REINFORCED CONCRETE DESIGNER and DRAUGHTSMAN REQUIRED IMMEDIATELY. Must have previous experience with specialist firm. State age, salary required, and full particulars, with dates of previous experience.—Address, 7088, The Engineer Office. 7088 A

STRUCTURAL STEELWORK.—Experienced LEADING DRAUGHTSMAN, able to Supervise and Carry Through Jobs complete. Also good DETAILING DRAUGHTSMAN REQUIRED for London. State age, experience, salary, and when free.—Address, P3940, The Engineer Office. P3940 A

WANTED, Experienced TOOLROOM FOREMAN, with some knowledge of general production for engineering work, &c., with firm about 40 miles north-west of London. One who has had experience in taking charge during the absence of principals preferred. State age, experience, and wages required.—Address, 7067, The Engineer Office. 7067 A

WANTED for London IMMEDIATELY, a Thoroughly qualified and practically experienced FOREMAN, 40 to 60 men; age 35 to 40. Large jobbing engineering; no call for garage or marine experience. Salary, £5 10s.—Address, P3936, The Engineer Office. P3936 A

WANTED for Manchester District, First-class Plant Maintenance FOREMAN. Experience with Horizontal Compound Drop Valve Engines, Lancashire Boilers and Green's Economisers essential. Apply by letter in first instance, giving full particulars of experience, age, and remuneration required.—Address P3934, The Engineer Office. P3934 A

WANTED, LEADING HAND PIPE FITTER and ERECTOR. Man who can instruct and supervise work from beginning to its erection. Must be practical and able to read drawings. Experience in Pipe Welding and Metric System an advantage.—Apply, MICHELIN TYRE CO., Ltd., Stoke-on-Trent. P3932 A

SITUATIONS WANTED

AS RESIDENT ENGINEER on Heavy Bridge, Dock or Railway Work. Highest references.—Address, P3862, The Engineer Office. P3862 B

ASSIST. BUYER, 6 Yrs.' Exp. of Engineering, foundry, blast-furnace materials, markets and routine, matriculation, shorthand typist, DESIRES NEW EXPERIENCE.—Address, P3919, The Engineer Office. P3919 B

ENERGETIC YOUNG ENGINEER, Hons. Degree Eng., knowledge German, Dutch, French, experience shops, D.O., erection, estimating and consulting work, SEEKS POSITION requiring initiative, home or abroad.—Write, BM/ABEX, W.C. 1. P3896 B

ENGINEER (35), 1st Class B.O.T., Experienced as chief engineer, reciprocating, turbine, electrical and pumping machinery, also superheated steam, DESIRES APP. in United Kingdom.—Address, P3923, The Engineer Office. P3923 B

For continuation of Small Advertisements see page 3.

SLIPPING BELTS——
SLIPPING PROFITS!
"High Test" Belting gives highest transmission efficiency possible, because:
32 oz. duck with frictioning between plies— therefore greatest flexibility with greatest strength
Vulcanised under tension— therefore cannot stretch on drive
Friction surface— therefore cannot slip
No seams at edge— therefore cannot open or disintegrate
Vulcanised under heat— therefore unaffected by conditions indoors or out
Specially impregnated material— therefore longer life under oily conditions—unharmed by acid fumes
Manufactured by:
The British Goodrich Rubber Co., Ltd.
SOLE AGENTS:
Bell's United Asbestos Co., Ltd.,
Southwark Street, London, S.E.1.
HIGH TEST BELTING
ASBESTOS
BELL'S ASBESTOS

A Seven-Day Journal

Pier Reconstruction at Newhaven.

THE announcement is made that the directors of the Southern Railway Company have authorised the expenditure of close upon £100,000 for the reconstruction in reinforced concrete of the east pier at the port of Newhaven. It is nearly fifty years since the existing timber structure was begun under the auspices of the Newhaven Harbour Company. Since its original construction the pier has been extended, and it is now a little over 500 yards in length, with a lighthouse at the end. The timber work is open at the top, but is sheeted up to about 5ft. above low water level, so that the sheeting forms a groyne and prevents the silting up of the harbour mouth by sand and shingle. Considerable wastage of the timbers has taken place owing to exposure, and the new structure will be entirely built in reinforced concrete. It is understood that special pile-driving machinery will be employed for putting down the new piles and pile sheeting, while a system of travelling gantries is to be erected to facilitate delivery of the material required for building the new pier. In general the new design, we understand, will follow closely that of the present pier. The contract has been let to the firm of Jackaman and Sons, of Slough, and it is hoped that the work will be completed within two years.

Public Works in Spain.

THE scheme of public works which is to be carried out in Spain is one of the largest and most comprehensive that has yet been put in hand, covering as it does the utilisation of the resources of a vast country at present practically untouched. It was dealt with fully at a recent meeting in Madrid by the Minister of Public Works, who declared that Spain intended to show the world that she was capable of accomplishing great things. The works comprise mainly the utilisation of hydraulic energy, the construction and improvement of railways and the building of roads and harbours. The Minister declared that the estimated cost of 5000 million pesetas did not imply the actual provision of that sum, for he believed that more than one-half of the amount would be covered by revenue from the works as they were being carried out. The remainder would be met by the increased wealth of the country. The rivers will supply an abundance of electrical energy, and will at the same time develop the agricultural industry by irrigation. It is intended to encourage motor traffic and bring tourists into the country by laying out good roads, while an extension and improvement of the railway system will aid in the general economic prosperity and open up many parts of the country that are at present practically isolated. For many years to come Spain is likely to offer a particularly promising field for engineering enterprise.

Reduction in the Naval Programme.

FURTHER particulars are now available with regard to new naval construction in the current financial year. Since the First Lord of the Admiralty announced last week that two of the three cruisers projected for this year would be deferred, it has become known that one of these vessels is to be cancelled. Another one may be transferred to the 1928–29 programme, but this step will depend, no doubt, on future developments in the political sphere. The remaining ship, a "B" cruiser, of about 8000 tons, is to be laid down at Devonport towards the close of the financial year, but the Navy Estimates provide only £8586 for work on this vessel up to the end of March. The building slip at Devonport has remained vacant since the launch of the cruiser Devonshire on October 22nd. Much disappointment is expressed at Portsmouth at the loss of the 8000-ton cruiser which was to have been laid down there this year, and it is feared that more men will have to be discharged from the dockyard as a result of the Government's action. No change is to be made in the programme of light construction, which comprises one flotilla leader, eight destroyers and six submarines. All these vessels are to be built by contract, and it is understood that specifications have now been received by the firms invited to tender. While the omission of the two cruisers will have very little effect on the present Navy Estimates—the total saving is only £9500—it will relieve next year's Estimates to the extent of nearly £1,500,000.

A New German Passenger Liner.

THE new liner Cap Arcona, which has been built by Blohm and Voss for the Buenos Aires service of the Hamburg–South American Line, sailed from Hamburg on her maiden voyage on Saturday last, November 19th. She is the largest vessel in her owners' service, and has the following principal dimensions:—Length over all, 680ft.; breadth, 84ft.; and depth, 46ft.; with a normal service draught of 26ft. 3in.; and a measurement of over 27,000 gross tons. Her three funnels and high superstructure give her a distinctive and pleasing appearance. State-room, cabin and public-room accommodation is provided for about 570 first-class passengers, 270 second-class and 520 third-class, which, together with a crew of 630, gives a total ship's complement of 1990 persons. Holds are provided to carry about 500 tons of cargo. The propelling machinery comprises a twin-screw arrangement of single-reduction turbines, designed to give the ship a service speed of 20 knots. Steam is raised in eight double-ended, oil-fired, water-tube boilers, designed for a working pressure of about 280 lb., the total temperature of the superheated steam being 600 deg. Fah. The total power of the turbines is 24,000 S.H.P., and by using reserve nozzles 27,000 S.H.P. was obtained on the trial run. The turbines all run at 2150 r.p.m., which is reduced to 125 r.p.m. at the propellers by single-reduction gearing. The main gear wheel of each set of machinery is coupled to the propeller shaft through a thrust bearing, and is centrally placed in relation to the high-pressure, first and second intermediate-pressure and low-pressure turbine units. There are two pinion shafts, one on either side of the main gear wheel. The inner pinion shaft has the high-pressure turbine at the forward end and the low-pressure aft, while on the outer pinion shaft the two intermediate-pressure turbines are arranged one at either end. High and low-pressure astern turbines with an output of 60 per cent. of that of the ahead turbines, are built into the second intermediate-pressure and low-pressure turbine casings. For lighting and power purposes there are four oil engine driven generator sets, each of 380 kW capacity, which work in conjunction with a cylindrical exhaust gas boiler.

Armstrong's and Vickers'.

ADDITIONAL particulars are now available regarding the terms of the scheme for the partial amalgamation of Vickers Ltd. and Sir W. G. Armstrong, Whitworth and Co., Ltd. The new company to be formed will be called Vickers-Armstrong, Ltd., and will have a capital not exceeding £21,000,000. It will take over the armament, naval shipbuilding and heavy and special steel departments of the two firms. Included in the works to be taken over are Vickers' establishments at Sheffield, Barrow, Eskmeals, Erith, Dartford, Swanley, Eynsford and St. Albans, and Armstrong's at Elswick, Ridsdale and Openshaw, and the Naval and Walker shipyards on the Tyne. The Vickers works at Weybridge and Crayford, the Metropolitan Carriage Wagon and Finance Company, the Metropolitan-Vickers Electrical Company, and other Vickers subsidiaries not engaged in shipbuilding or armament work will not be taken over. The purchase price for the works coming under the scheme will be satisfied by the allocation of shares in the new company, in which Vickers will hold the larger interest. Similarly, the stock-in-trade, stores and work in progress, other than ships in course of construction, will be purchased at a valuation, the purchase price being satisfied by the allocation of shares in the new company, together with £600,000 in cash in part payment to Armstrong's. The new company will grant Armstrong's a lease of the Walker yard for a period of twenty-one years, with an option to purchase it within five years. An interesting detail connected with the finances of the new company is that its profits are to be insured with the Sun Insurance Office, Ltd. If the profits during any one of the next five years fall short of £900,000, the insurance company will contribute a sum not exceeding £200,000 in each such year. During the fifteen years succeeding the last payment made under the policy by the insurance company, that company will be entitled to 40 per cent. of the profits earned in excess of £900,000, the sum then recovered being limited to the amount paid by the Sun Office during the five years covered by the policy, together with interest at 6 per cent.

An Important Clyde Launch.

A LAUNCH of particular interest took place on Wednesday morning, the 23rd inst., at the Dalmuir Yard of William Beardmore and Co., Ltd., when the first of four passenger liners which are being built on the Clyde to the order of the Canadian-Pacific Steamships, Ltd., safely took the water. The new vessel was appropriately named the Duchess of Atholl by the Duchess herself. Among the principal hull particulars we may mention the following:—Length, 596ft.; breadth moulded, 75ft.; depth moulded, 53ft.; loaded draught, 27ft.; with a measurement of about 20,000 gross tons. The propelling machinery, which has been designed under the personal supervision of Mr. J. Johnson, the chief superintendent engineer of the owners, marks an important advance in the direction of utilising higher steam temperatures and pressures. The twin-screw single-reduction geared turbines of the Beardmore-Parsons type, have a total output of about 18,000 S.H.P. and will be supplied with steam at 350 lb. pressure, with a total superheated steam pressure of 725 deg. Fah. The boiler installation is a combined one, and comprises high-pressure boilers of the Yarrow type, with Yarrow superheaters and air heaters, which work in conjunction with Scotch boilers. Make-up water is fed to the Scotch boilers only, the water-tube boilers being fed with condensate. The Yarrow boilers were designed by Messrs. Yarrows, but were built by Messrs Beardmore's at Dalmuir. The main condensers will be of the Weir regenerative type. Many of the engine-room auxiliaries will be electrically operated. The electric generating equipment includes two 500-kW steam turbine sets and two 500-kW oil engine driven generators. The results obtained from this highly modern arrangement of propelling and auxiliary machinery will be awaited with unusual interest. On the day following the launch of the Duchess of Atholl, the launch of the 10,000-ton cargo liner Beaverbrae at Armstrong-Whitworth's yard, made a total of seven Canadian-Pacific vessels, aggregating over 72,000 tons, which, within two months, have been launched in Great Britain. This, we believe, constitutes a world's record in any shipbuilding programme.

Wages in the Shipbuilding Industry.

A CONFERENCE took place on Thursday of last week, November 17th, at the Ministry of Labour, in connection with the deadlock which has arisen concerning the application of the workers in the shipbuilding trades for an increase of 10s. per week, with a proportionate advance to pieceworkers. There were present the permanent officials of the Ministry of Labour and representatives of the shipbuilding and engineering trade societies, who were joined by representatives of unions outside the Federation of Shipyard Workers. At the close of the conference, which lasted over two hours, it was officially stated that the Ministry of Labour would again approach the employers. It will be recalled that at the last joint conference between the Shipbuilding Employers' Federation and representatives of the trade unions the employers stated that this question was not one which, in their opinion, having in view the present state of the industry, could be referred to arbitration. They put forward the suggestion that both parties should sit down together and hammer out a definite index of trade prosperity by which wages might be assessed. At the conference we have referred to it is understood that one proposal was that the Ministry of Labour might again get in touch with the employers and seek their consent to an inquiry under an independent chairman being made.

Proposed Convention on Safety of Life at Sea.

IT is announced that the Board of Trade has issued through the Foreign Office a memorandum containing certain proposals for a revision of the International Convention of 1914 on Safety of Life at Sea. It has also put forward the suggestion that a conference should be held in London in the autumn of 1928, with a view to amending the existing Convention. Although the provisions embodied in the 1914 Convention were unanimously agreed to by representatives of practically all countries, the Convention was, on account of the war and other causes, not ratified by all the signatory Powers, and as yet it does not constitute a completely international standard. Meanwhile considerable technical advance has been made, and the British authorities have now laid before their colleagues in the memorandum referred to some suggestions as to various directions in which, in their opinion, the provisions of the 1914 Convention might with advantage be amended. These are grouped under the following headings:—Subdivision of Ships; Life-saving Appliances; Wireless Telegraphy; Fire Extinguishing Appliances; Ice Patrol; and Collision Regulations. If there is a general consensus of opinion that such amendments might profitably be made, then the British authorities propose to issue invitations for another conference, which it is proposed should be held in London in the autumn of 1928.

The Late Sir A. F. Pease.

IT is with great regret that we learn of the death of Sir Arthur Francis Pease, who was seized with illness while attending a meeting of Horden Collieries, Ltd., on Wednesday last, and died soon after being removed to his home at Middleton Lodge, Middleton Tyas, near Darlington. Sir Arthur, who was sixty-one years of age, was the eldest son of the late Mr. Arthur Pease, and was the elder brother of Lord Daryington and a cousin of Lord Gainford. He was born at Darlington in 1866 and received his education at Brighton College and Trinity College, Cambridge. After leaving Cambridge he spent some time in the head office of Pease and Partners, Ltd. Later he joined the board of directors and ultimately became managing director and then chairman and managing director. Owing to failing health, Sir Arthur latterly gave up the position of chairman to Lord Gainford. Among other numerous industrial undertakings with which Sir Arthur was intimately connected were the North-Eastern Railway Company, the Forth Bridge Railway Company, Horden Collieries, Ltd., and the National Benzole Company. He was a valued member of the Durham Coal Trade Association, the Cleveland Mineowners' Association, and of the Durham Conciliation Board. Sir Arthur Pease was the second Civil Lord of the Admiralty during the period 1918–19, and the following year he was elected High Sheriff for the County of Durham. His death at such a relatively early age will be deeply regretted by a wide circle of industrial and private friends.

The Mid-Cheshire Electricity Scheme.

THE supply of electricity in Mid-Cheshire commenced in the year 1896, when the Northwich Electricity Supply Company was formed and the power station operated by Mond gas supplied by means of a pipe line from the works of Brunner, Mond and Co., Ltd., operated continuously from that year until May, 1927. Originally mains were laid in Northwich and the adjoining suburb of Hartford. Gradually, however, the undertaking extended its area of supply to the very limits of a three-wire direct-current system, by the use of peak-load sub-stations in the outlying districts of Hartford and Davenham, and two-battery sub-stations in Northwich.

In the year 1912 a village electricity supply scheme was commenced at Weaverham, about 2 miles from Hartford, by the Weaverham Electricity Supply Company, Ltd. A small suction gas power station was erected at Acton Bridge, on the river Weaver, and the villages of Weaverham and Acton were supplied with direct current by a three-wire overhead system. In 1913 a single-phase 3300-volt alternating-current underground main was laid from Weaverham to Sandiway, a distance of 3 miles, for the purpose of dealing with that residential district and the adjoining village of Cuddington, on the borders of Delamere Forest. A kiosk containing two transformers and switchgear was provided at Sandiway to reduce the pressure to 230 volts. Underground low-pressure mains were laid from the kiosk for about half a mile, the remainder of the distribution system being overhead. During the war, however, the Weaverham undertaking proved unsuccessful. The power station costs increased, and the lighting restrictions resulted in such a reduction in the income that in 1920 it became necessary to ask the Northwich company to take over the undertaking. The Weaverham power station was consequently shut down, and a three-phase 3300-volt overhead feeder was run from Northwich to Weaverham terminating in the sub-station —Fig. 10, on page 600—which also forms the local depôt, and the undertaking was leased to the Northwich company, pending purchase. The Northwich direct-current generating plant provided the alternating current, by supplying through two 100-kilowatt rotary converters operating inverted.

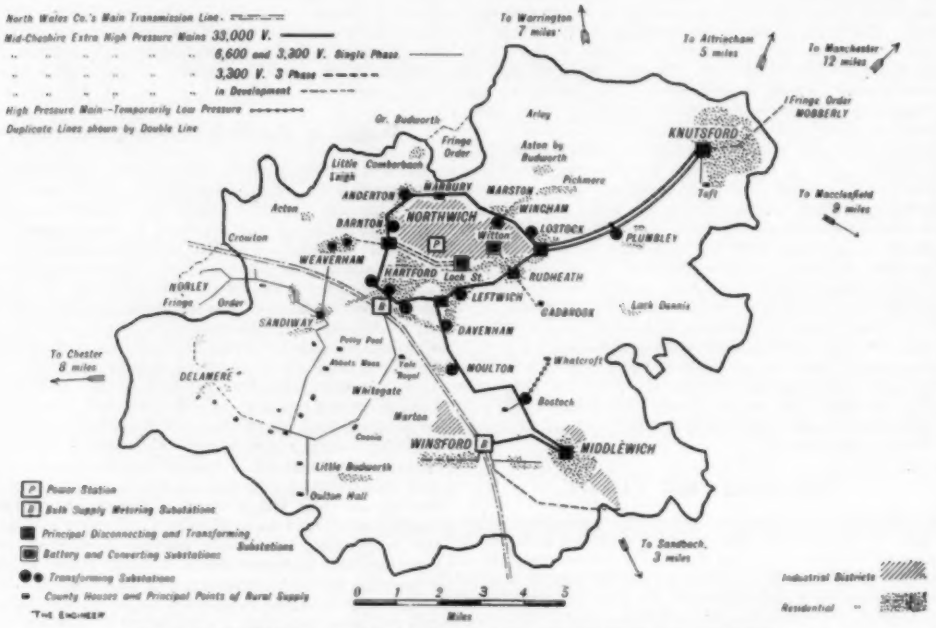

FIG. 1—MAP SHOWING OVERHEAD LINES AND SUB-STATIONS IN CHESHIRE

As it was necessary for the Northwich company to obtain new powers to take over the Weaverham area, and as the neighbouring towns of Knutsford, about 6 miles to the north-east, and Winsford and Middlewich, about an equal distance to the south of Northwich, had no public supply of electricity, it was decided to include those towns and the surrounding country districts in the application to the then newly appointed Electricity Commissioners. As the scheme involved four urban districts and two rural districts, a considerable amount of time was taken over the negotiations; it was, in fact, over three years from the date of application before the Order was granted in 1924. In the year following, the Northwich company changed its name to the Mid-Cheshire Electric Supply Company, Ltd. The company's engineer, Mr. W. Fennell, prepared in 1923 a complete scheme to deal with the whole area, which includes four towns and an area of 120 square miles. The first section of the scheme, to cope with the demand in Hartford, Davenham and Northwich and to handle the Weaverham area, was put into operation in 1924. A temporary bulk supply was obtained at 600 volts three-phase from the Salt Union's works at Meadow Bank, near Winsford, and the pressure was transformed to 33,000 volts to suit the new scheme.

During 1923–1924 the Electricity Commissioners sanctioned the erection of a 33,000-volt overhead transmission line between Runcorn and Crewe for the purpose of supplying the eastern end of the North Wales Electricity District from the Mersey Power Company's power station at Weston Point, Runcorn. The line was intended to pass between Sandiway and Delamere, but as a result of negotiations between the Commissioners and the Northwich company, the route was altered to pass through Hartford, 1½ miles from Northwich, and the line was duplicated in order to provide an adequate bulk supply for the mid-Cheshire area. This transmission line is indicated on the map, Fig. 1, which shows the area of supply, the extra high-tension lay-out, and other details of the scheme. The Meadow Bank bulk supply was discontinued and the new bulk supply brought into use in August, 1926. As the scheme is a complete and recent one intended to deal with a large area and designed to supply towns, suburbs and remote rural districts, a general description of the lay-out may prove of interest, especially as it has been carried out by a company unaided by Government financial assistance.

The transmission line is tapped at two points, namely, at Hartford and Winsford. Fig. 11, on page 600, shows the bulk supply switching and metering station at Winsford, which is also the transforming station for that town; also for a high-pressure single-phase country line, which feeds in the direction of Stanthorne, and for a three-phase power line to Cledford, south of Middlewich. Apart from the fact that it gives no local supplies, the general lay-out of the Hartford bulk switching station is similar to that at Winsford. The duplicate transmission lines are connected through single 33,000-volt Pirelli cables to Ferguson Pailin oil-filled H.V. type switches, having a breaking capacity of 750,000 kVA. There is also a metering cubicle, of the drop-down type, containing duplicate potential transformers. The three units are placed inside the building and are operated by lever gear from a separate switch room, which also contains the meters, &c. The bus-bars of the high voltage switch gear are connected through cables to the Mid-Cheshire bus-bars, which are fixed above the roof. The outgoing Mid-Cheshire 33,000-volt Pailin outdoor type "U.A." switches, provided on each mains are connected to the bus-bars through Ferguson side with air-break isolating switches. These switches are operated by lever gear from the switch room below.

FIG. 2—MIDDLEWICH SUB-STATION

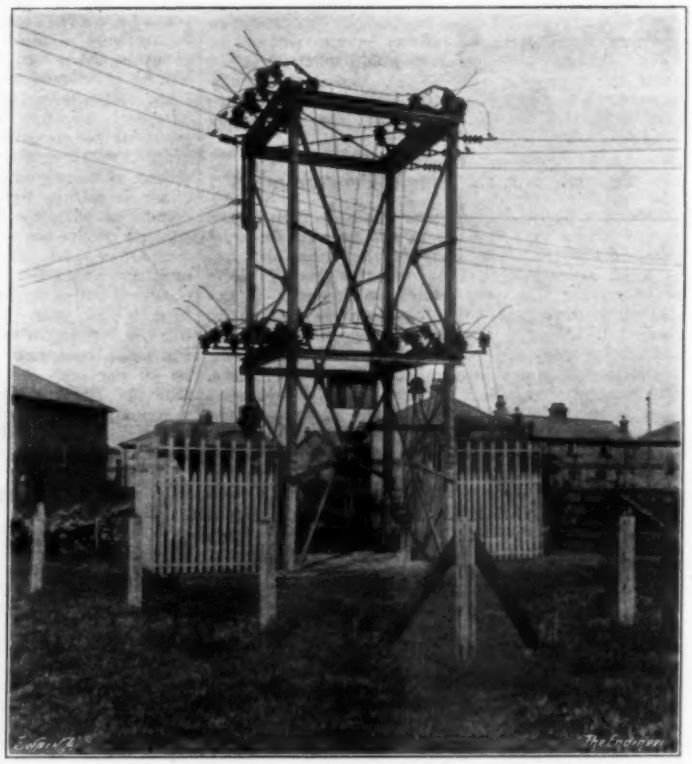

FIG. 3—RUDHEATH ISOLATOR AND SUB-STATION

The main development has been carried out with a three-phase 50-cycle 33,000-volt system. An overhead ring main, carried on A poles, encircles Northwich and receives its bulk supply from the Hartford bulk sub-station, and portions of this main are to be seen in several of the illustrations. Isolating switches are provided on the incoming and outgoing mains at structures, situated at the Hartford bulk sub-station, Wallercote, Rudheath, Marbury, Lostock Gralam and Davenham. For a distance of 5 miles a 33,000-volt line proceeds from the Davenham structure to the south, passing through Moulton—where there is a pole-isolating switch—and thence to Middlewich, where there is a switching structure and transforming sub-station of special design, as shown in Fig. 2. The line proceeds from

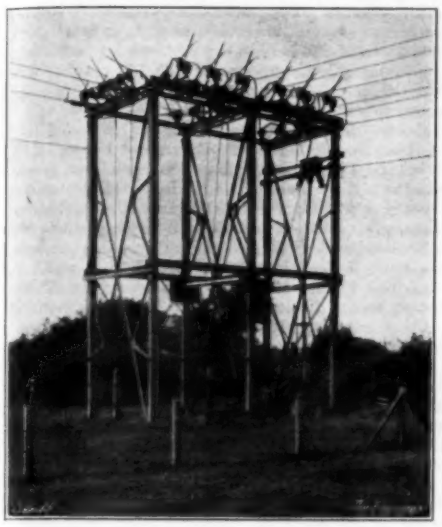

FIG. 4—LOSTOCK GRALAM SWITCHING STATION

Middlewich to the Winsford bulk sub-station shown in Fig. 11 on page 600, where it again connects through an isolating switch to the bus-bars, and thence to the Runcorn-Crewe line.

From the Lostock Gralam switching structure, shown in Fig. 4, a duplicate line proceeds through Plumbley, where there is on each main an isolating switch, to the Knutsford terminal structure and sub-station similar to that at Middlewich. The isolating structures and pole isolators are so arranged that the whole of the 33,000-volt mains can be isolated into sections of two or three miles, and, as the principal tappings are taken from bus-bars on the structures, any section can be made dead without interrupting the service on the tapping. From the plan Fig. 1 it will be seen that the routes of these 33,000-volt mains have been chosen not only to connect the four towns involved, but to pass through and to be as near as many villages as possible, so that local supplies can be given by the cheap forms of sub-stations to be described.

The Wallercote switching and transforming structure shown in Fig. 13 on page 600 was the first structure to be erected on the first section of the new system in the year 1924. The 200 kVA Metrovick transformer in front of the structure is for supplying the Weaverham area at 3300 volts through the three-phase overhead line on the left of the illustration. The 33,000-volt side of the transformer is controlled by an air break switch and fuse, also manufactured by the Metropolitan-Vickers Electrical Company. At the rear of the structure there are two 300 kVA transformers manufactured by the English Electric Company, used for reducing the pressure to 6600 volts for the Northwich Lock-street supply. The three-circuit line leaving the structure is a good example of heavy power line construction. It consists of the 33,000-volt ring main and the duplicate 6600-volt circuit extending to the Northwich Lock-street sub-station. The line was constructed by British Insulated Cables, Ltd. Further on the special river crossing shown in Fig. 12 on page 600 carries the 33,000-volt ring main across the river Weaver to Barnton, leaving ample clearance for the masts and derricks of vessels using the waterway. The towers supporting the phosphor-bronze span, which is 500ft. long, were constructed by W. J. Yarwood, of the Dock, Northwich. The latest type of line isolator and outdoor sub station designed by Mr. Fennell is shown in Fig. 3. It supplies the Rudheath housing scheme and the Witton sub-station at Northwich. It acts as an unstayed angle pole and is similar to several others on the main line. The air break switchgear on these structures was supplied by Ferguson Pailin and Co., Ltd., to meet the engineer's special requirements, and is provided with the Metropolitan-Vickers Electrical Company's horn break 33,000-volt fuse, which has given very satisfactory results on the whole system. Owing to the comparatively large number of direct-current motors in use at Northwich, and their suitability for the work they have to perform, such as operating swing bridges, the Anderton boat hoist, shipyards, &c., it was decided to retain the direct-current three-wire system in that locality. The distances to the outlying suburbs, &c., were, however, too great to allow that system to continue even in conjunction with battery sub-stations, and in consequence the ring main was made to pass through Hartford, Davenham, and Rudheath. The local mains at these places were disconnected from the direct-current system and supplied with alternating current so as to relieve Northwich of load and to improve the pressure on the outskirts. Fortunately, there were few electric motors in these suburbs. At Hartford the demand had entirely outgrown the underground mains and feeders. By choosing three suitable points for the single-phase sub-stations the load has been balanced fairly equally on the three phases, and the farthest consumer is now only one-third of his previous distance from the feeding point. The old mains are now quite large enough for their work, great expense has been avoided, and the local battery sub-station has been shut down.

The illustration Fig. 5 shows the new Lock-street sub-station which contains Bruce Peebles - La Cour converters. A fiveway truck cubicle receives the two incoming 6600-volt mains from the Winnington structure to supply the converters, one being spare. The contract for the cubicles and the new direct-current switchboard was placed with the Metropolitan-Vickers Electrical Company. To cope with subsidence, the sub-station is capable of being lifted in one piece, and in this respect it is perhaps unique. The machine foundations are also specially designed for independent lifting and levelling, and both operations can be performed without putting the plant out of operation. The second sub-station, at Witton, a mile away, is supplied at 3300 volts by an underground cable from the Rudheath sub-station. This station, which is at present outside the subsiding area, contains the two 100 kW rotary converters originally used for the Weaverham supply and now removed from the power station. Both the stations contain Tudor storage batteries. As the sub-stations are on opposite sides of the subsiding areas, additional safety is provided in the event of mains defects.

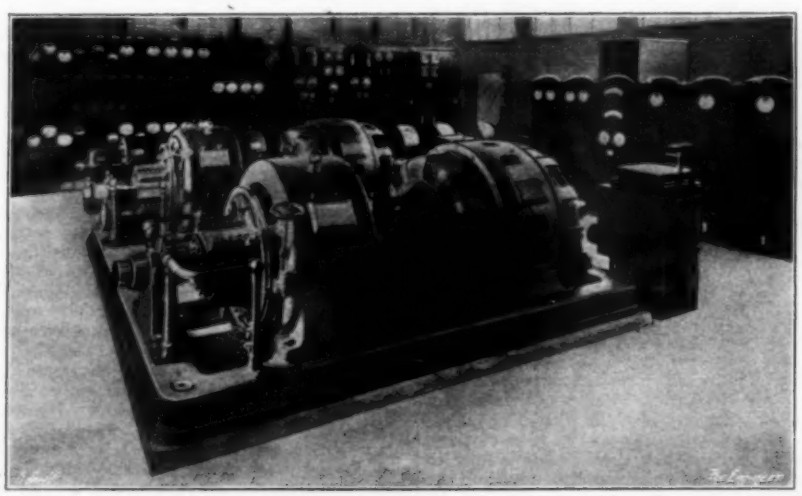

FIG. 5—LOCK STREET CONVERTER SUB - STATION

The three "new" towns, Knutsford, Middlewich, and Winsford, and the large village of Barnton are all supplied on the three-phase four-wire system with underground lead-covered armoured cables in the central areas and overhead mains, where necessary, in the outskirts, and Lostock Gralam is now being developed on the same system. The Middlewich terminal sub-station—Fig. 2—which is similar to that at Knutsford, contains a four-wire low-pressure switchboard and accessories supplied by Metropolitan-Vickers and serves as a local centre for small repairs, &c. The main line contracts were let to three firms: British Insulated Cables, Ltd., was responsible for the ring main; Siemens Bros. for the Southern section; and the Foundation Company for the Lockstock to Knutsford section. The work associated with secondary and rural supplies, and the erection of outdoor sub-stations and switchgear was carried out by the company's own staff.

As regards country developments, Mr. Fennell had to solve the problem of providing simple and cheap outdoor sub-stations, suitable for tapping the 33,000-volt lines for outer suburbs, village supplies and for step-down tapping points for secondary lines for rural work. The first four outdoor sub-stations erected during 1923–1924 were of the type shown in Fig. 6, which shows one of the three of the Hartford sub-stations. These sub-stations consist of two 33,000-volt switch fuses, supplied by the Metropolitan-Vickers Electrical Company, erected on a pole at a safe and convenient height, namely, about 14ft.

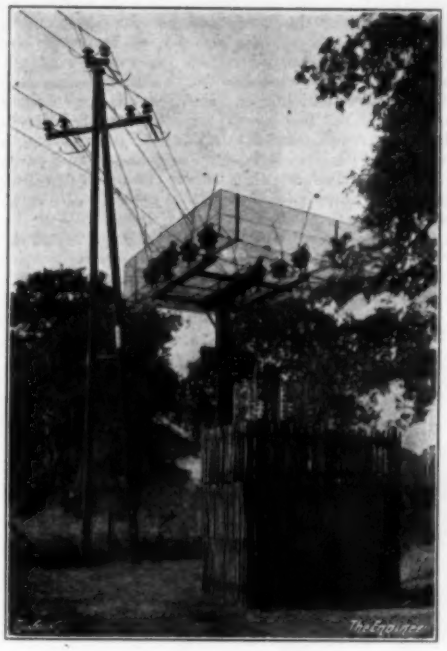

FIG. 6—HARTFORD SUB - STATION

FIG. 7—BOSTOCK PARK SUB - STATION

between the line and the transformer, which was also supplied by the Metropolitan-Vickers Electrical Company. The transformer is placed upon a pedestal, whilst a feeder pillar, made by Mavor and Coulson, stands at a lower level and receives the low-pressure leads from the transformer. The local underground three-wire 220-volt cables were disconnected from the Northwich direct-current system, and connected to the feeder pillar, thus changing the system over to alternating-current working. Single-phase sub-stations of this type cost about £80, and three-phase sub-stations £100, excluding the transformer. The special feature which promotes cheapness and relia-

bility is the direct connection from the line pole to the switch and from the switch to the transformer by heavy and stiff leads which resist wind pressure and do not need insulation of any kind.

The second series of sub-stations is for supplying large villages adjacent to the 33,000-volt line, and at present four of these sub-stations are in use. A typical example of one of these novel sub-stations is shown in Fig. 7. It will be perceived that the line pole forms part of the sub-station structure, and that two short poles serve for supporting the transformer and switchgear. These poles also form a derrick for lifting the transformer into place. There is no pedestal and the whole of the work can be carried out by a linesman and mate. The absence of concrete and brickwork is a great advantage in country places. The 33,000-volt switches are modified Ferguson Pailin switches, which only take up a small amount of room, whilst the fuses were supplied by the Metropolitan-Vickers Electrical Company. The sub-station shown in Fig. 7 is in Bostock Park, about 250 yards from Bostock Hall, which is one of the finest Cheshire mansions. Sub-stations of this type cost £50 single-phase and £75 three-phase.

A third type of sub-station is shown in Fig. 8, which is even cheaper, namely, £35, the reduction in price being due to the absence of horizontal ironwork and enclosing fencing. The two poles which support the transformer, &c., are erected parallel with a line

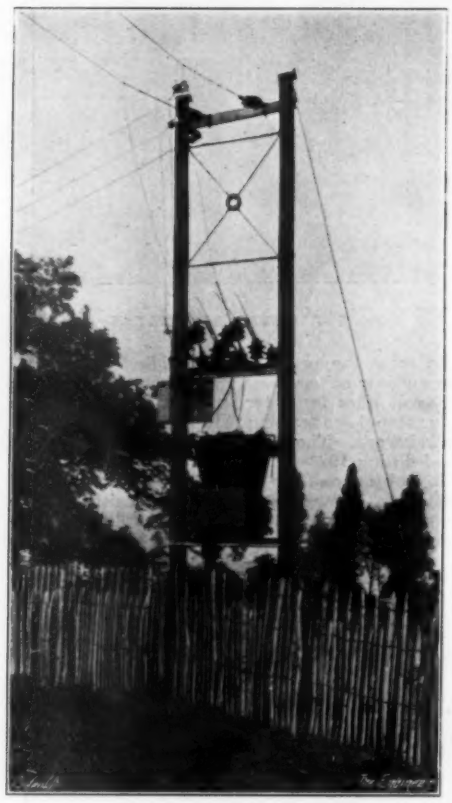

FIG. 8—SUB-STATION AT PLUMBLEY

pole at a suitable distance, and form the terminal point of a very short unfused branch from the 33,000-volt main and the commencement of the rural line. The switchgear is erected on ironwork fixed on the poles at a height of about 14ft. above the ground. Barbed wire around the poles prevents unauthorised persons gaining access to the live parts. On a new 33,000-volt line an H pole can be given a width of about 5ft. to take the transformer, and the expense of the separate pole is avoided.

One of the main objects aimed at by the engineer was that the transformer should only have to be raised a few feet above the ground, and that the operation of raising the transformer should be performed in one simple lift. It was also deemed essential to place the switch fuse half way between the transformer and line, so that safe access could be gained to the transformer and fuse at any time by opening the switch. The line wires, it will be noted, are still at a considerable height above the switch, thus avoiding damage to the lines by the arc formed on the horn breaks when the fuse operates. The operator also is a safe distance from live parts when replacing a fuse. The sub-station illustrated in Fig. 8 is at Plumbley, which is a point of origin of a rural 3300-volt single-phase line route.

Single-phase 3300-volt lines were developed in the first instance as extensions of the Weaverham system after it was taken over. One line extends from "The Blue Cap," Sandiway, 5 miles into the heart of Cheshire Hunt, towards Tarporley, and another runs from Cuddington into Norley and returns towards Delamere. These lines supply the Hunt headquarters and eight or nine mansions, in addition to the villages of Little Budworth, Upper Cuddington and Norley, and a number of small country houses, and even cottages *en route*. Pole transformers of from 3 to 10 kilowatts capacity are in general use, and they are controlled by fuse oil switches which have proved to be best for the rather cramped positions on the poles. An example of this form of equipment is shown in Fig. 9. The cost of these lines is about £250 per mile. On these remote extensions of the system several single-phase motors are at work. One of the machines is a "Century" 20 horse-power motor, which is used for driving a circular saw on the Oulton Hall estate at a distance of 8 miles from the main line.

In Mr. Fennell's opinion, single-phase working is almost necessary for real rural work, because the cost of line, transformers and switchgear is reduced to a minimum and the transformer losses are less than those on a three-phase system. As all farm machinery is designed to be driven by a petrol engine which has to be started by hand, the low starting torque of single-phase motors without commutators

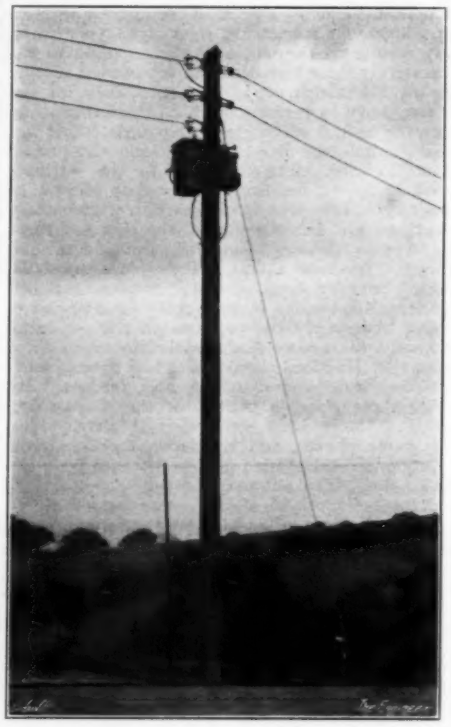

FIG. 9—SIMPLE POLE TRANSFORMER SUB-STATION

is not a handicap. But, notwithstanding the relatively low cost of single-phase lines as compared with the cost of three-phase lines, it is necessary still further to reduce the cost before rural lines can be operated on a commercial basis in areas where only a purely farming and village load can be obtained. This reduction in cost can only be secured by the introduction of modified electricity regulations, particularly those governing the height of poles and presumed ice loading of conductors, which at the present time unnecessarily increase the cost in sparsely populated areas. There must also be assurance of more reasonable treatment on the part of the Post Office which at present exposes electricity undertakers to unnecessary expense in respect of elaborate, antiquated and costly methods of guarding at crossings, &c. As we have previously explained, the Post Office even claims half the cost of protection when it is second in the field, and this unknown liability often causes electricity supply undertakers to hesitate to carry out work which only offers a slight margin of profit that may easily vanish if the Post Office chooses to erect a line in the same area at a later date. One of the early developments of the Weaverham company, namely, the supply of the straggling village of Acton at 220 × 2 volts has proved that in these days of electric cooking, radiators, &c., it is folly to run low-pressure lines more than half a mile from the source of supply, for a lighting load only can be accepted in that locality.

In Canada with the Empire Mining Congress.

(From a Delegate to the Congress.)

No. III.*

AFTER a couple of days in the Rockies at Banff, among the snow-clad mountain peaks, we turned south-east again to Lethbridge, Alberta, missing a trip to the Turner Valley oilfields, by reason of the effect of rain on the earth roads in that part of Alberta. At Lethbridge a visit was made to the Galt colliery, operated by the Canadian Pacific Railway since 1912, when it was acquired from the Alberta Railway and Irrigation Company. The coal is a sub-bituminous domestic fuel, and is obtained from one 4ft. seam, lying horizontal, coal cutters of the punching type being utilised. Underground haulage is by endless rope on the main roads to the shaft bottom and gathering to the ropes is done by horses and Shetland ponies. The usual trip on the rope is twenty to thirty cars. The mine cars are hoisted two at a time, tandem, on the cage. Ventilation is by a double-inlet Sirocco fan, blowing 200,000ft. of air per minute with a water gauge of 4½in. at 246 r.p.m., requiring 275 H.P. Electric cap lamps are used by the workmen underground. Hardly any pumping is necessary, the daily quantity of water handled being 25,000 gallons, pumped by twenty-seven small pumps in the mine and one duplex plunger pump at the shaft, worked by compressed air at 75 lb. pressure. The power-house has three duplex air compressors, one with a capacity of 2100 cubic feet, and two of 2800 cubic feet of free air per minute, and two electric generators of 200 kW each. The steel tipple is electrically operated, and has provision for screening coal and separating it from rock.

The same day found the "Blue" Train at Blairmore, Alberta, and the "Red" Train at Fernie, B.C., both in the Crow's Nest Pass through the Rocky Mountains. Here visits were made to the mines and coal-washing plants of the West Canadian Collieries, the International Coal and Coke Company, Ltd., the McGillivray Creek Coal and Coke Company, and the Hillcrest Collieries, Ltd. We also had a sight of the terrible Frank landslide, reminding us of the horror of the night in 1903 when eighty persons in the village were engulfed by the fall of the top peak of the neighbouring mountain, undermined by water and by mine workings in its side. At Sentinel, Alberta, on the Crow's Nest Lake, I visited the electrical generating plant of the East Kootenay Power Company, which is established principally as a stand-by for the hydro-electric stations of the company at Aberfeldie on the Bull River and Elko on the Elk River. The Sentinel plant is capable of accommodating generating machines up to 10,000 kW capacity at 80 per cent. power factor, with steam boilers. The existing turbo-generator is a 5000-kW Parsons, built at Newcastle-on-Tyne, operating at a normal speed of 3600 r.p.m., at a boiler pressure of 225 lb., with 150 deg. superheat. The condenser is of the Parsons type. The boilers are Robb-Mumford, built by the Robb Engineering Company, each with a heating surface of 6650 square feet, with a normal pressure of 225 lb., and are fired by pulverised coal. The fuel is dropped from overhead bunkers of 300 tons capacity to Simplex pulverisers, unit type, each boiler having two burners and each pulveriser being capable of supplying both boilers. Each pulveriser is driven by a Terry steam turbine and one pulveriser has an auxiliary electric motor drive. The boilers are fitted with Elesco steam superheaters for 150 deg. superheat, and have water-cooled floors. The feed water is softened on the "Permutit" system, and has a Cochrane type heater, the pumps being Weir turbo. The stack is 211ft. high, 17ft. in diameter at the base and 11ft. at the top. The outdoor sub-station will accommodate duplicate lines with the necessary remote control oil switches, lightning arresters and a single transformer bank consisting of three star-delta, 6600–66,000-volt transformers, 2000 kVA capacity, with one spare—all water-cooled out-door type.

The following morning found the two trains together at Kimberley, B.C., where we were privileged to visit, a week or so following the Prince of Wales and Prince George, the world's greatest lead-zinc mine—the famous Sullivan mine, which produces more than 1,100,000 tons of exceedingly complex ore annually, the reduction of which baffled the metallurgists until wartime necessities led the way to discoveries which exercised a notable effect on the supply of zinc for the needs of the Allied nations. We entered the mine, after a motor drive up a narrow mountain path, by an adit 3900ft. above sea level, and rode 2 miles into the bowels of the earth by electric train. Our subsequent experiences included Alpine climbs through enormous stopes lighted by searchlights and large enough to hold a good-sized house. From these stopes the blasted rock is drawn by drag line scrapers operated by compressed air, and having a working radius of 250ft. Six-ton electric locomotives operating at 250 volts are used for haulage on tracks laid with 45 lb. rails on a 36in. gauge, and electric battery locomotives are used for assembling trains. Air-driven mucking engines are used in driving the main adit.

The mine power plant near the main portal includes a water-driven compressor coupled to an auxiliary steam engine and electrically-driven compressors, the whole having a capacity of 15,000 cubic feet of free air per minute. Electricity delivered at 2200 volts is supplied by the East Kootenay Power Company to an underground sub-station where it is stepped down to the proper voltages for the various mine uses.

The preliminary crushing of the ore is done at a mill which takes it by gravity from the portal of the main adit down to the Canadian Pacific Railway cars waiting on the line at the foot of the mountain. The ore is first put through jaw crushers, which are followed by gyratories set to 2½in. From the bins there it is taken 3½ miles in 68-ton cars to the great concentrator on the other side of Kimberley, where,

* No. II. appeared November 18th.

by the pressing of a button, the cars are made to dump the ore on to scales and thence to an 1800-ton coarse ore bin. A train of ten cars takes less than 9 minutes to dump.

The milling operations here are extremely complicated, although the concentrator is one of the best designed to be found anywhere, its daily tonnage being now 4000 tons, soon to be raised to 6000. Power comes from the East Kootenay Power Company's plant at Bull River. Nearly all the machines in the mill are driven by individual motors, 160 being in use, ranging from 1 to 200 H.P. From two to three thousand horse-power is needed to run the mill at capacity. Concentrates are conveyed from the filters to circular steel loading bins, one for zinc concentrates and the other for lead concentrates, both of which discharge into railway cars.

A steamer trip on Kootenay Lake on the following day, and we were at Nelson—after a fleeting visit to the old Bluebell lead mine at Riondel. From the first-named city we took train to the Upper Bonnington Falls hydro-electric power plant of the West Kootenay Power and Light Company, where 60,000 H.P. is generated for use in the mines, mills and smelters of the parent concern—the Consolidated Mining and Smelting Company, Ltd. We were entertained to dinner at a building near the 75,000 H.P. plant now under construction at Lower Bonnington Falls, where we were informed that the power demands of the local industries would within ten years call for the provision of not less than 300,000 H.P. of electrical energy. From the Upper Bonnington Falls plant two transmission lines deliver power to the Trail smelter at 60,000 volts and two at 20,000 volts. At the smelter it is stepped down to 2200 volts, and distributed to departmental sub-stations, where it is again stepped down to 550 volts, which is the standard everywhere, except in the zinc refinery, generator rooms and rod mill, where 2200 volts are used. The total power requirements of the Trail works amount to 66,000 horse-power.

An article many times larger than this would be necessary adequately to describe the great Trail smelter, where we spent two brief hours on September 12th. The plant covers no less than 160 acres, and there are 27 acres of roofing on the buildings. It employs 2500 men and produces 400 tons of lead, 280 tons of zinc, 60 tons of copper, and 20,000 oz. of silver per day, in addition to 2500 oz. of gold and smaller quantities of other metals every month. The smelter produces about 10 per cent. of the world's supply of lead and nearly the same proportion of its zinc.

The next day took us through the British Columbia apple-growing country to Princeton, by way of the Kettle Valley Railway, a mountain line of many dizzy trestle bridges and hair-pin bends. At Princeton we were transferred to a special train, on which we proceeded to the mine and concentrator of the Granby Consolidated Mining, Smelting and Power Company, Limited, at Copper Mountain, 5000ft. up—a scenic trip of great beauty. The party was elevated to the mine itself, which is at the very summit of the mountain, by a kind of cliff railway, our cars being hauled to the top at the end of a very slender wire rope. In the mine the ore—largely bornite and chalcocite—is broken in glory holes, from which it runs through ore passes to the 3945ft. level, whence it is trammed by electric motors and dumped into the main ore pass leading to the pocket on the 3170ft. level. From this pocket it is next transferred by electric motors to the crushing plant near the No. 3 tunnel portal, on its way to the railway bins, whence it goes out by rail to the concentrator lower down the mountain. Power is transmitted to the properties from the West Kootenay Company's plant at Bonnington Falls. The concentrator was examined by the party at some speed, shortly after dinner in one of the mine buildings, and after an adventurous descent on the fearsome cliff railway. It has a daily capacity of 2000 tons and produces a copper concentrate which is smelted at Trail by the Consolidated Company on a custom basis. In 1926, 669,306 tons of ore handled were found to contain 3985 oz. of gold, 137,480 oz. of silver, and 17,752,253 lb. of copper.

After a night journey to Vancouver, we embarked immediately by steamer Victoria, being considerably interested *en route* to observe the sharp line of demarkation stretching far out in the strait and dividing the waters of the Fraser River from salt water. The quantity of silt poured into the ocean here must be enormous, and will perhaps one of these days revive some mediæval idea of floating a company to extract the valuable minerals which may or may not be lost to mankind in this way. We returned to Vancouver from our day at the capital city by way of Howe Sound—a great fjord in the mainland coast north of Vancouver. At Britannia Beach the party visited the concentrator of the Britannia Mining and Smelting Company, Ltd., which handles about 3000 tons of copper ore daily from the mine higher up in the hills overhanging the beach. The 1926 production was 1,156,470 tons of ore, containing 9995 oz. of gold, 148,113 oz. of silver, and 30,954,479 lb. of copper. Besides the copper concentrates, a by-product of iron pyrite is recovered and sold to sulphuric acid plants. Although we had no time to see the mine itself, I understand that in the workings all the ore is made tributary, through long transfer raises, to a main ore-raise, which delivers it to crushers on the 1700ft. and 1800ft. levels, where it is crushed until all will pass through the 2½in. ring. From the bottom of the main ore-raise, 4330ft. from the main adit portal, the ore is transported in 17-ton cars drawn by electric locomotives over a switch-back railway with a 3 per cent. gradient, 3½ miles to the top of a rock-raise 1500ft. deep. It is dropped down this to a second adit on the 4100ft. level, again loaded into cars, and hauled by electric locomotives to the mill bins at the portal of the second adit, another 4000ft. journey. The company operates in all thirty-one electric locomotives, and power for the mine and concentrator is generated locally on the Britannia, Mineral and Furry Creeks, from which in good seasons a maximum of 6000 H.P. is available. Another 6000 H.P. is purchased from the British Columbia Electric Railway Company, which transmits the power from North Vancouver over a distance of 30 miles along the shore line of Howe Sound.

During our stay in Vancouver for the technical sessions and a great banquet, some of us had an opportunity of inspecting one of the great lumber mills, where huge cedar or Douglas fir logs, 5ft. or 6ft. thick, are raised by chains from the river, barked and sawn into baulks, planks and laths of every size, and eventually converted into beautifully panelled doors and other articles. Almost every operation, apart from selection and the carpentry work, is mechanical, and the output of the mill is enormous. The logs and planks move on rollers to the saws and are deflected into channels or turned over at will by levers, the operators' work consisting merely in examining the plank to see if it is symmetrically cut or if it should be sent off on another chain of rollers for sawing into smaller sizes.

From Vancouver on the following day our journey took us eastward—and homeward—up the Canadian National main line through the Fraser, Thompson, and North Thompson river valleys, through the Yellowhead Pass to the Jasper National Park, where two glorious days were spent among the snow-clad mountains, including a charming drive along a fine asphalt and gravel road to the glacier at Mount Edith Cavell. We interviewed the black bear in his own lair in the woods, and endeavoured unsuccessfully to persuade Nature's greatest engineer, the beaver, to teach us the secret of his art.

(To be continued.)

The Public Works, Roads and Transport Exhibition.

No. II.*

We continue below our account of the exhibits at the Public Works, Roads and Transport Exhibition, which was held at the Agricultural Hall, Islington, during the course of last week.

William Jones, Ltd., of 154–5, Upper Thames-street, London, E.C. 4, was showing various types of railway material for public works contractors, &c. The most noteworthy exhibit was the little petrol locomotive illustrated in Fig. 9. It is of what its maker calls his "Montania" type, and its gauge is variable from 18in. to 30in. Its engine is of 7½ horse-power nominal on petrol, and the locomotive is said to be capable of hauling up to 38 tons on the level at a speed of 2½ miles per hour, or 17 tons at a speed of 17 miles per hour. On the straight level the draw-bar pull which it can exert at 2½ miles per hour is given as being 842 lb., while at 5 miles per hour it is said to be 400 lb. The maximum gradient at which it will operate is 1 in 15, and on that incline it can handle a 3-ton load. Its engine is of the vertical type with a cylinder 4in. in diameter by 4½in. stroke, and the fuel consumption is stated to be 0·58 pint per H.P. hour with petrol and 0·66 pint with paraffin. Its weight in working order is 2·3 tons and altogether it looked a handy little machine.

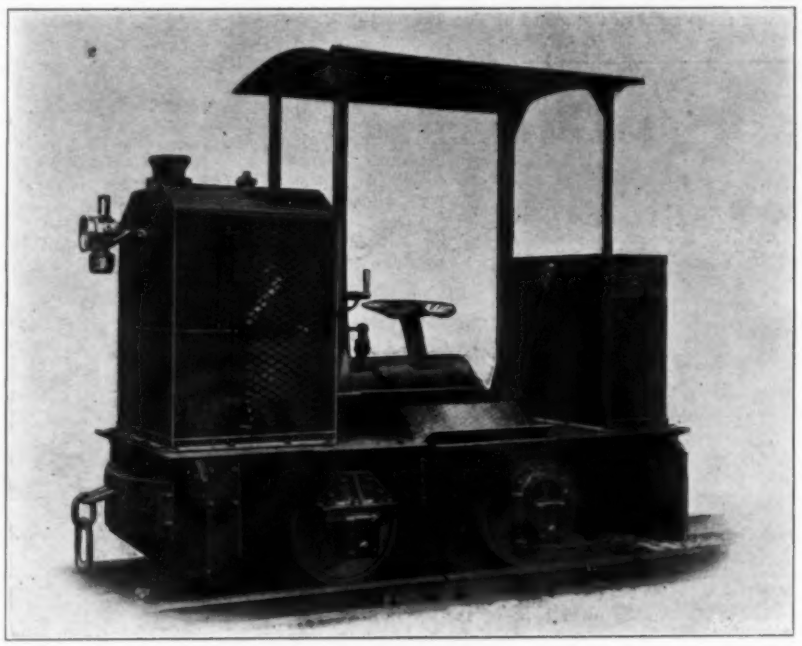

FIG. 9—"MONTANIA" PETROL LOCOMOTIVE—WM. JONES

William E. Farrer, Ltd., of Heath Mill-lane, Birmingham, was showing practically the same things as it had at the last Exhibition, the only new thing being an anti-flood valve in which the ordinary sheet copper ball of the valve is replaced by a vulcanite ball which has a rubber seating. It is claimed that as the new ball is practically indestructible the life of the valve is greatly increased as compared with that of a valve with a metal ball. The maker calls attention to the following points:—(*a*) The valve can be fixed anywhere in the line of the drain; (*b*) one valve can be made to serve two or more drains; (*c*) the inlet and outlet can be fixed at different angles; (*d*) there is no water seal to choke or silt up; (*e*) all parts are accessible and the special seating and vulcanite ball are easily removable when necessary; (*f*) the construction preserves a fullway flow; and (*g*) the valve can be arranged as a fresh air inlet valve if required.

The Phœnix Engineering Company, Ltd., of Chard, Somerset, had on view one of its "Phœnix Extra Rapid" patented bitumen spraying machines, which has a capacity of 160 gallons. The machine is fitted with a powerful double-acting spraying pump, the suction of which is controlled by a valve of special design that is embodied in the base of the pump and is so arranged that one movement changes from "Work" to "Hot Air," and *vice versâ*. The other exhibits on this stand included a rock asphalt heater, a road drying and patching equipment, some contractors' pumps, &c.

Hadfields, Ltd., of Sheffield, had in motion one of its "Hecla" disc crushers made in accordance with Symons' patent. Our readers are familiar with the construction of this machine, so that there is no occasion again to describe it. It will suffice to say that the crusher is intended specially for the production of uniformly cubical "chippings" for the top dressing of roads, concrete, &c. The size of the machine exhibited is that known as the 24in., and it is capable of accepting feed pieces ranging up to 5in. by 4in. by 2½in., and of converting the stone into ¾in. ring material at the rate of approximately 15 tons per hour. On the same stand was one of the firm's 12in. by 4in. granulator type of jaw crusher designed to turn out ¾in. cubes at the rate of 4 tons per hour. On the stand, too, there were numerous examples of various types of steel products likely to be of use to contractors, road engineers, &c.

Baird and Tatlock (London), Ltd., of 14 and 15, Cross-street, Hatton-garden, London, E.C. 1, always have interesting shows whenever they exhibit, and the recent occasion was no exception to the general rule. We cannot, of course, refer to everything on their stand, but special mention may be made of an apparatus for the testing of bitumen and tar for use in road and other work, and also of a selection of apparatus for the testing of coal and petroleum by-products.

John Allen and Sons (Oxford), Ltd., of Cowley,

* No. I. appeared November 18th.

Oxford, showed an interesting vehicle which they have just completed. It is a self-propelling roller somewhat of the caterpillar type, with four separate tracks, one replacing each of the ordinary wheels. The two rear tracks are driven by toothed gearing. The tracks are flexible, saving where they come in contact with the ground, and then they are automatically rigidly locked to a radius of something over 30ft. Their effect on the ground is said to be similar to that of a wheel of that diameter. The firm also showed a road roller overhauled and modernised so as to be capable of filling all up-to-date requirements in the way of road repairs, and also a "Parsons'" trench excavator designed to dig trenches 2ft. wide and 7ft. deep.

F. C. Hibberd and Co., Ltd., of 98, Great Tower-street, London, E.C. 3, exhibited examples of their handy little petrol locomotives to which we have referred in past years. These machines are fitted with Dorman engines and are made for gauges varying from 15in. up to standard, in weights varying from 1¾ to 8 tons, and for quite light work, such as that in brick-fields, up to heavy loads of 150 tons or so.

The Wallwin Company, of Warwick, showed a collection of its non-chokeable pumps, one of them at work and passing a heterogeneous assortment of solid substances in addition to water.

A number of machines for road construction and maintenance was to be seen on the stand of Thomas Coleman and Sons, Ltd., of Derby. Among them was a "Flapper" spraying machine. It has a capacity of 250 gallons, but the type is made in sizes varying from 50 to 1000 gallons capacity. This machine has neither pumps nor brushes and is claimed to be remarkable for the rapidity with which it sprays the road surface with a perfectly even coat of tar or bitumen. The width of spray can be varied up to 5ft. 6in. by an arrangement of sleeves operated by levers at each side. On this stand, too, was the Coleman patented "Arch" boiler for heating tar, pitch, or bitumen, a grit spreading machine, a concrete mixer, &c.

Johnston Brothers, of 79, Mark-lane, London, E.C. 3, always have the same positions at these Exhibitions, and always have a thoroughly workmanlike display. There were the usual huge asphalt plant, and other machines for roadmaking and maintaining, and a novelty in the shape of the firm's 1928 pattern of bitumen boiler with patented reservoir squeegee attachment. This apparatus embodies a tubular melting grid arranged above the main cauldron, which is said to have proved very valuable for the rapid melting of fresh bitumen fed to the boiler from time to time. The reservoir squeegee attachment is claimed to be unique in the speed and efficiency with which it is able to resurface a road with bitumen or bitumen compounds.

Tuke and Bell, Ltd., of Lichfield, contented themselves this year by showing a couple of vehicles, one a self-propelling car with a 30-cwt. "Morris" chassis, intended to serve the dual purpose of a house refuse cart and for general haulage work. For the former it has a capacity of 120 cubic feet and for the latter 51 cubic feet. The other vehicle was a low-loading dustcart with a capacity of 3¾ cubic yards.

W. Weeks and Son, Ltd., of Maidstone, showed their 1.A.B. automatic pressure bitumen or tar-spraying machine and their 2.C.P.H.B. continuous-working power-driven hand bitumen or tar-spraying machine and other machinery and boilers for dealing with tar, bitumen or similar substances.

Noticeable on the stand of Holman Bros., Ltd., of Camborne, was a 210–220 cubic feet petrol portable air compressor set of new design and mounted on rubber-tired wheels. The engine and compressor were coupled together by means of a clutch which incorporated a patented flexible joint.

Cooke, Troughton and Simms, Ltd., of 15–17, Broadway, Westminster, are another firm of instrument makers which can always be relied upon to have an excellent exhibit. Prominent on their stand this year was a selection of beautifully made levels of various types.

H. R. Marsden, Ltd., of Leeds, of course, showed stone crushing machinery of various patterns. Among them was its latest type of granulator, size 30in. by 6in., which has been specially designed to meet the ever-increasing demand for small broken stone or "chippings."

Winget (1924), Ltd., of Grosvenor-gardens, Westminster, had, as usual, an extensive display of different types of machines for making concrete, concrete blocks, bricks, &c. A machine which particularly attracted our attention is illustrated in Fig. 10. It is known as the 8½/6 Roadmaker, and it embodies several interesting features. For one thing, the concrete mixing unit is mounted on a rigidly constructed turntable on which it can be swivelled and locked in four different positions. By the removal and re-fixing of a single bolt the machine can be converted from end to end loading and discharge or *vice versâ*, the steerage of the chassis being maintained in whichever direction the machine is working. This model is driven by a 5 H.P. slow-speed petrol engine and it can be fitted—as indeed it was at the Exhibition and as seen in our illustration—with a distributing chute 8ft. long, which gives a 16ft. radius of action. When the distributing chute is fitted the mixing unit can work in four directions at right angles to one another. The chute has a hinged extension so that it can be operated either over a 12ft. or a 16ft. circle.

It would be impossible in the space at our disposal

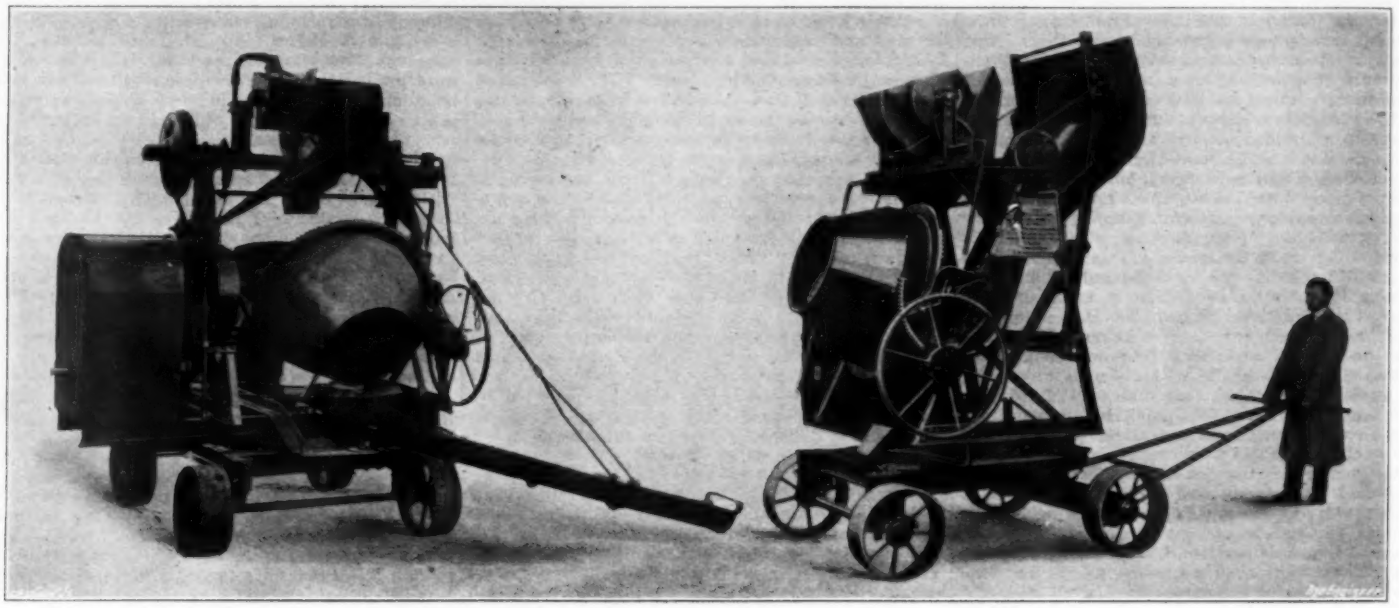

FIG. 10—CONCRETE MIXER WITH TURNTABLE AND DISTRIBUTING CHUTE—WINGET

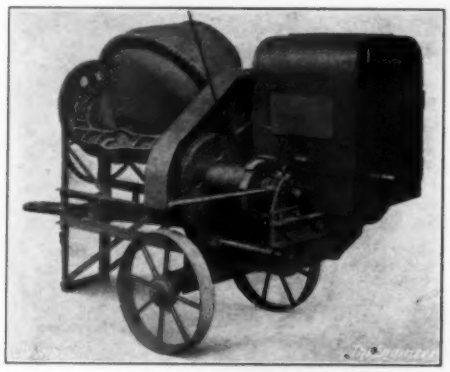

FIG 11—7/5 MIXER WITH HOIST—WINGET

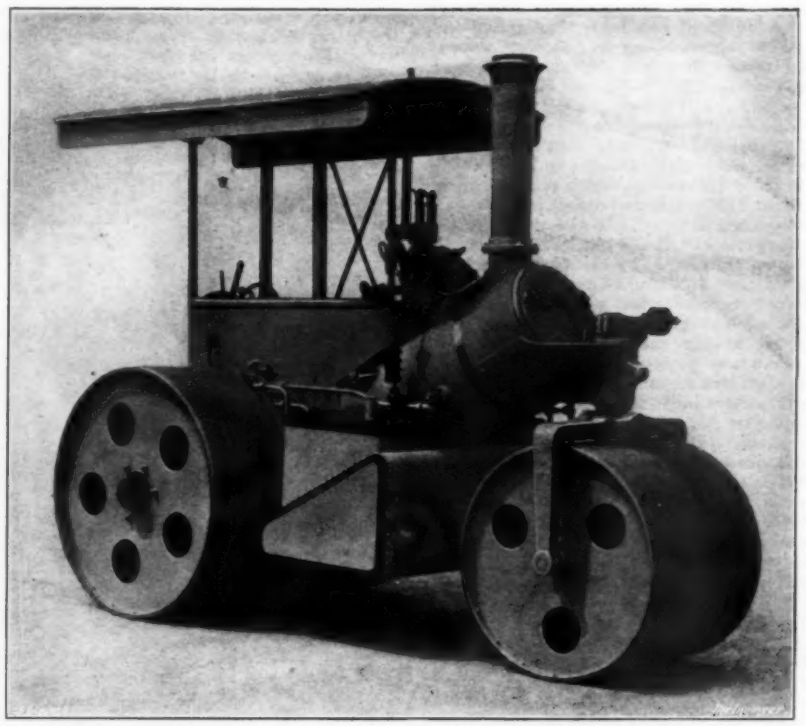

FIG. 12—3¼-TON STEAM ROLLER WITH INCLINED BOILER—WALLIS AND STEEVENS

even to give a list of all the Winget machines that were to be seen, but mention may be made of a development of the original chain spade mixer, in which the chains have been replaced by a series of specially designed spades mounted on curved arms carried on a central horizontal revolving shaft. The spades are adjustable and can readily be renewed.

We may also refer to the mixer with the hoist attachment, which is illustrated in Fig. 11. The machine shown is known as the 7/5 mixer, and the average speed of lift with the hoist is said to be 60ft. per minute with a normal load of 6 cwt. up to a maximum load of 8 cwt. The unit is fitted with a 3½ H.P. engine and the hoist can be operated while the drum itself is mixing.

Stothert and Pitt, Ltd., of Bath, had an exhibit which was very similar to that which they had a couple of years ago. There was their No. 7 tar-macadam plant, with its double shaft paddle mixer of 7 cubic feet capacity, which is designed for an output of from 35 to 50 tons per eight-hour day. Then there was the Smith mixer, suitable for either tar-macadam or concrete, two sizes of Victoria mixers for concrete, and a tip cart of 7 cubic feet capacity.

The Ingersoll-Rand Company, Ltd., of 16, Queen Victoria-street, London, E.C. 4, again had a very large stand and showed, this year, a dozen or more novelties, including a rock drill sharpener, new types of jack hammers, rock drills, paving breakers, &c.

Wallis and Steevens, Ltd., of Basingstoke, nearly always have something novel and interesting to show. This year it was the little roller illustrated in Figs. 12 and 13, which is intended for light work, such as setting tar, grit patching, &c., and also for making up and rolling yards, entrances, sports grounds, estate roads, and the like. Its distinctive feature is its boiler, which, as will be observed, is inclined. Indeed, the machine, at first sight, reminded us irresistibly of the engine of a mountain railway train. The boiler is of a quite new pattern, which, we understand, has been patented, and has been specially designed to combine the good points of the locomotive and vertical types and to avoid their disadvantages for road rolling work. It consists of a plain cylindrical outer shell with a cylindrical fire-box, the aim being to ensure an entire absence of internal projections and corners and of fire-box stays which might accumulate deposits and interfere with cleansing. In fact, the latter, so the makers claim, is actually greatly facilitated, as any mud or other deposited material tends to fall to the mud doors, which are arranged at the lower end and through which it is readily cleared. Both the tube plates are inclined so that the tubes at their front ends are, under all normal conditions, fully covered, and Messrs. Wallis and Steevens point out that even on very stiff gradients—unless the water level was abnormally low—they would, if temporarily uncovered, still be protected by splash from damage. The furnace front is in one casting and, since it is held in position by bolts, is easily renewed, and the front roller saddle being, as will be observed, attached underneath, instead of at the top of the smoke-box, allows of easy access at the front end for sweeping tubes and other attention, a facility which is not possessed by all rollers. The weight of this little roller in working order is approximately 3¼ tons and its rolling width is 5ft. The machine was certainly among the greatest novelties of the Show.

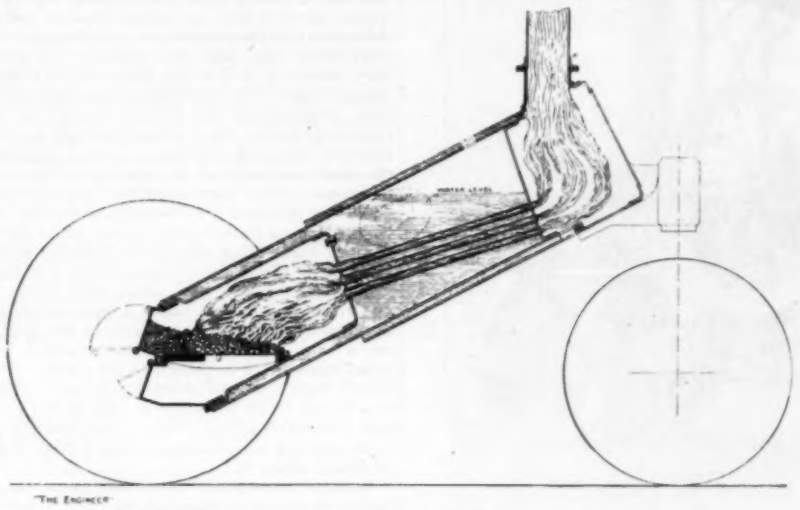

FIG. 13—SECTION THROUGH INCLINED BOILER—WALLIS AND STEEVENS

Other exhibits on this stand included a 10-ton "Advance" roller, a surface gritter, &c.

Mr. G. H. Blakemore, of 180, Piccadilly, London, W. 1, had on view a number of his "Super" machines and equipments. Among them was a portable petrol-driven air compressor plant, which comprised a compressor unit, a petrol engine of 25 H.P., radiator, air receiver, &c., all mounted on a steel chassis. The air compressor has a piston displacement of 121 cubic feet of free air per minute. Another "Super" exhibit was a contractor's trench pump equipment.

The British Steel Piling Company, Ltd., of Westminster, is another firm which nearly always has some novelty to show—usually a working model.

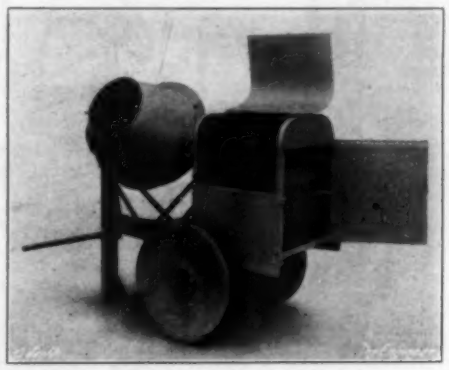

FIG. 15—SMALL CONCRETE MIXER—MARSHALL

This year, in addition to a huge completely equipped pile frame and other exhibits, there was a little working model showing the operation of a McKiernan-Terry automatic hammer, specially designed for pile driving under water. Such hammers will work under water at depths of 40ft. and over, and to enable them to do so a ¼in. diameter flexible hose is connected to an inlet at the side of the hammer for the purpose of admitting compressed air into the casing, so as to prevent water entering it, which would interfere with the reciprocating portion of the hammer. The air pressure required is 0·5 lb. per square inch for every foot of submersion, and the quantity of air required is, we were informed, so small that a little Westinghouse compressor, designed to work one pneumatic tool, is of sufficient capacity for the service. The steam or compressed air for operating the hammer itself is led to the valve in the usual way. If steam be used, a flexible tube is led to the surface for the escape of the exhaust. No trouble is said to be experienced from condensation when steam is used up to depths of 40ft. In one instance, one of these hammers —known as the 11 B—drove piles 80ft. under water, compressed air providing the motive power.

Frederick Parker, Ltd., of Leicester, had its usual imposing show, including its large stone drying and

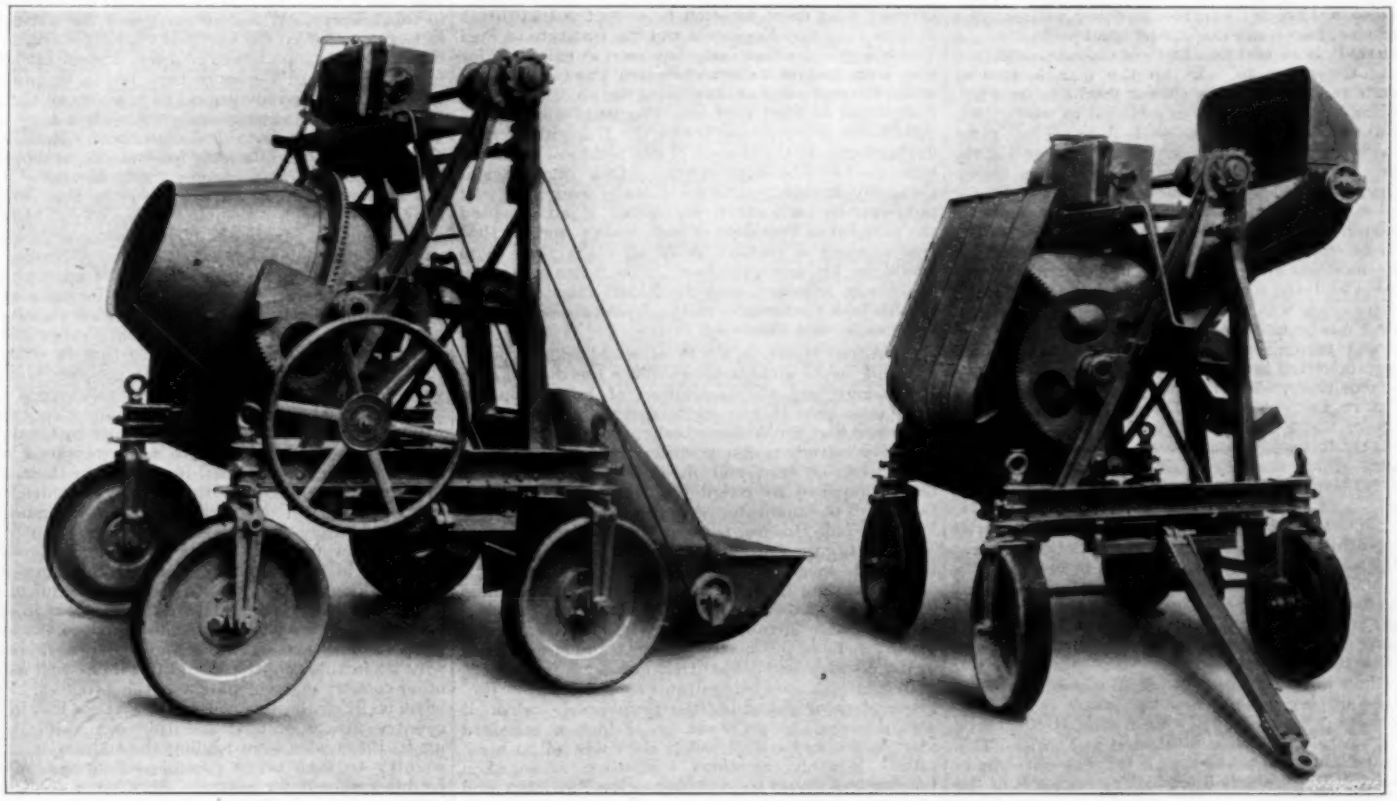

FIG. 14—"SIX-NINE" MODEL "MARSHALL-BENSON" CONCRETE MIXER

6-TON CRUDE OIL ROAD ROLLER

AVELING AND PORTER, LTD., ROCHESTER, ENGINEERS

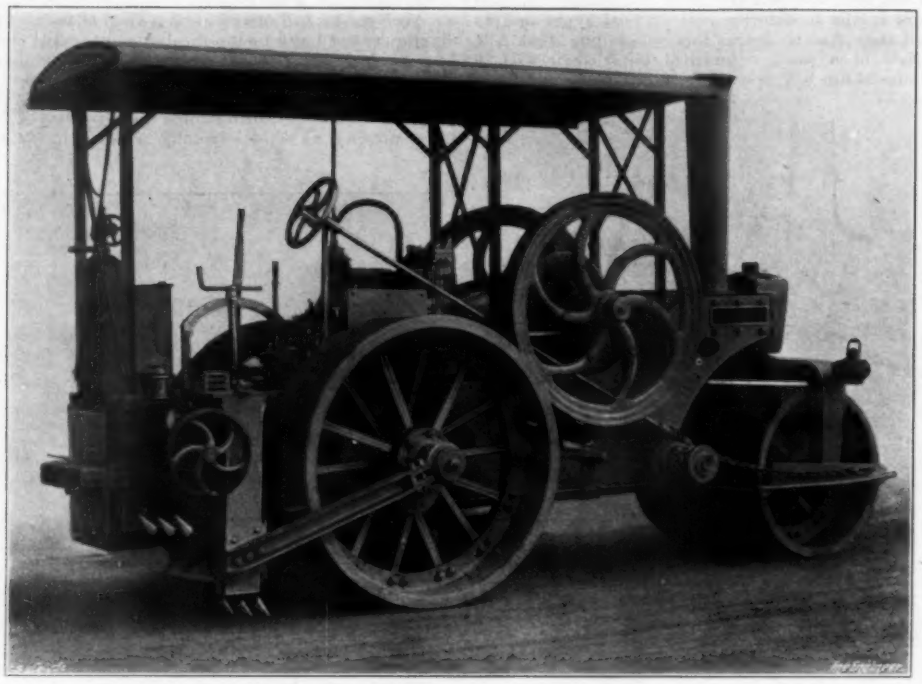

FIG. 16

tar-macadam mixing plant, a couple of concrete mixers, one of them capable of producing 50 cubic yards of mixed concrete per working day, and several stone crushers, including a 16 by 5 "Monarch" granulator for producing "chippings," ¾in. and under in size.

Robey and Co., Ltd., of Lincoln, had a typical display of steam and petrol rollers, one of the former with a steam steerage engine, and another being a 10-ton quick-reverse three-roller machine. There was also a 12in. by 8in. stonebreaker with a solid rolled steel frame and manganese steel jaws.

Marshall, Sons and Co., Ltd., of Gainsborough, are among the latest to take up the manufacture of concrete mixers and other similar machines for road-work, and on their stand, in addition to road rollers —steam and oil driven—we noticed an asphalt plant and several concrete mixers. Two examples of the latter—the "Marshall-Benson" mixers—are shown in Figs. 14 and 15. The larger of the two is known as the 6–9 model, which is similar in design, so we understand, to two other larger models with capacities up to 14 cubic feet per batch. The design is simple in its mechanical devices, and in construction the machine has been made specially robust to withstand the hard usage which is inseparable from the employment of machines of this type. By taking out a few pins and turning the wheels round, the machine can be converted in a few minutes from side delivery to end delivery. The motive power is a "Lister" petrol engine. The smaller machine—which is known as the 3–4 model—is designed for light jobs, and is made readily portable by a pair of travelling wheels. Both machines gave evidence that much care had been devoted to their design and construction.

There was nothing strikingly novel that we observed in this firm's steam rollers, though we noticed certain modifications in its "Universal" machine. For example, disc wheels have been employed instead of the usual spoke type, the cross tank has been made deeper and there have been some alterations—and, it is claimed, improvements—in the shape of the tender carrying the scarifiers.

Aveling and Porter, Ltd., of Rochester, had, as usual, a display of their excellent steam road rollers of various types, and they also showed the crude oil driven roller which is illustrated in Fig. 16. This roller, which is known as type "U," has a weight in working order of about 6 tons. The engine is of the four-stroke, horizontal type, and it is claimed for it that, as compared with a vertical engine, it has the following advantages:—(*a*) All its parts are readily accessible; (*b*) there is less wear and tear in the connecting-rod bearings, and in the crank shaft journals; and (*c*) the piston is thoroughly lubricated where its pressure is greatest, namely, along the bottom of the cylinder.

For this engine, no auxiliary fuel is necessary, nor is a starting lamp or other heating arrangement required, there being a compressed air self-starter, the air vessel of which is automatically kept charged by a small compressor while the engine is at work. There is only one lever for starting, stopping or reversing the roller.

(To be continued).

The Institute of Fuel.

No. I.

THE first conference for the discussion of technical subjects of the recently constituted Institute of Fuel was held at the Institution of Electrical Engineers, Victoria Embankment, London on Wednesday and Thursday, November 23rd and 24th. The Institute of Fuel is an amalgamation between the Institution of Fuel Economy Engineers and the Institute of Fuel Technology. Neither body has been in existence for very long, and for a short while they proceeded separately, the real point at issue being the objection of the Institution of Fuel Economy Engineers—which was established a short time before the Institute of Fuel Technology—to the absence of any technical qualification for membership of the other organisation. Curiously enough, quite accidentally and in a way unknown to each other, Sir Alfred Mond accepted the position of President of both bodies, and for that reason alone it seemed likely all along that there would be an amalgamation. The differences were eventually adjusted, and Sir Alfred Mond presided at the first Conference of the Institute of Fuel on Wednesday and Thursday.

Sir Alfred Mond, in his Presidential address, after referring to the amalgamation of the Institute of Fuel Technology and the Institution of Fuel Economy Engineers, said it was with regret that he had to announce that Sir William Larke, owing to the many duties involved in his position with the National Federation of Iron and Steel Manufacturers, had been compelled to resign the chairmanship of the Council of the Institute. A successor had been found in Mr. Frank Hodges, who, of course, knew the fuel problem from every possible angle. He was pleased to be able to announce that the membership of the new Institution showed an increase over the combined membership of the two original Institutions. A class of "Collective Members" had been established, and already some of the most progressive and largest firms in the country had joined that class.

Regulations were being drawn up in no narrow professional spirit governing the membership, which it was intended to maintain at as high a standard as possible, and a Fellowship class was to be instituted. Monthly meetings had been arranged in London and would be extended to the Provinces, and at the present time it was intended to issue a quarterly journal, to be followed later by a monthly journal, which would contain a bibliography of the fuel literature of the world.

After giving a brief outline of the subjects to be discussed during the meeting, Sir Alfred Mond said that some little time ago he accepted the chairmanship of the National Fuel and Power Committee, which was set up by the Government to investigate the possibility of effecting economies in fuel and power in this country. That Committee had already held a large number of sittings, and had examined a considerable number of most important and interesting problems. The scope of the inquiry was a very wide one, because the Committee had been asked to look into the whole problem generally. Therefore, it had been necessary to hear a great deal of evidence. The Committee had not issued a report even of a preliminary character, although he hoped that in a not too distant future one report, at any rate, would be issued. He did not wish to forestall the conclusions of the Committee, but there were a few things which had struck him personally in the investigation. One was that we still had a great deal to learn about handling coal from the time of its existence in the mines to the washery, in transportation, and in its further use, and although it would be unfair to say that our collieries were inadequately equipped, there were, nevertheless, a great many old-fashioned collieries, and there were some problems in connection with them that had not received the study which they deserved, and which they should obtain at the present time. The methods of washing and screening coal generally in use to-day seemed to be extraordinarily crude. Having been brought up in the more delicate chemical industry, he was horrified to see the methods adopted at so many collieries, but yet he was told that they were the only methods which could be adopted. Personally, however, he was a little sceptical that improvements could not be made if more engineering talent and research were applied to some of the primitive machinery now being used. Fortunately, many new ideas were being discussed and tried, and he had taken a little personal interest in a new washing process which, as far as it had gone on a semi-technical scale, had proved itself very remarkable, as it enabled the ash to be reduced from a very high figure to about 2 per cent. That process was about to be installed at one of the collieries he was interested in, and after it had been working for some time on a commercial scale a little more would be heard about it.

Some evidence had also been given to the Committee as to the position of the coke industry in this country, and that evidence might be published one day. If that were done people would be rather surprised, because it was not satisfactory. There was in this country a large number of small and antiquated coke ovens, and when they were compared with some of the enormous installations in the United States and the bigger installations in the Ruhr and other parts of the Continent, it was realised that in this industry there was still a great deal to be done. A cheap coke was essential for the revival of the heavy metal industries because we could not expect our pig iron producers to go on competing with foreign competitors if the price of the essential raw material was very much higher than the price paid for the same raw material by their competitors. There was still a great want of co-ordinated research work in this country. When one compared the work done in Germany before the war, and continued ever since, with the work done in this country, it made one absolutely blush. In Germany they had a magnificent centrally equipped institution to examine all the fuel problems of the various collieries, with a very large number of able men to deal with them. Here, however, we were still relatively backward. Attempts at co-operation were becoming more successful, but the amount of money that people in this country seemed to consider adequate to spend on research was absolutely fantastic. The Germans dealt in what he called mass research work. Where we in this country would have two pieces of apparatus at work on a particular problem the Germans would have one hundred. If the Germans were endeavouring to obtain coal from oil they would put up, not two plants but one hundred plants, so that in studying the effect of pressure they could get one hundred variations right away. That obviously saved very much time and eliminated their difficulties very much more quickly. Results were obtained in Germany, not because the Germans were better people or more brilliant than we; it was due solely to their more systematic working and the extent to which they spent money on research. Unless the industries of this country took those problems seriously to heart they would find themselves in a very short time displaced in the industries of the world, and rightly displaced simply because of the higher technical efficiency and better scientific work carried out in other countries. It was impossible to stop the march of progress of science and ideas, and there was no reason why we in this country should not do as well as any other country in developing scientific progress. From what he knew, he was convinced that we had in this country plenty of able scientific men, and it was up to those who were leading the industries of the country to take every possible advantage of the facilities offered for research work on a continuous and growing scale.

Finally, Sir Alfred Mond drew attention to the manner in which the economic development of the nation is bound up with scientific development in fuel-producing and using industries. The whole history of the world showed that civilisation had advanced in stages just as human invention had developed. Only by the provision of cheaper fuel, better utilisation of fuel, cheaper power and cheaper products generally, would it be possible for the nation as a whole to increase its spending power, and in turn improve the prospects for the industries of the country generally.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

"THE MAN AND THE JOB."

SIR,—The letter written by "Engineering Commonsense" on the above subject has done much in reviving my hopes, and for that I feel particularly grateful to your correspondent.

During the last twenty-five years, the period in which I have been a student of the technical Press, there have appeared at intervals articles similar to your leading article in THE ENGINEER of November 11th, and letters from your readers discussing the education, status, rewards, &c., of engineers in general; these three somehow appear to be inextricably mixed up, and I trust that, on this occasion, the first time I have ever "written to the Editor" about it in my life, you will be good enough to permit me to give expression to a few thoughts that have occurred to me with varying degrees of intensity during that time.

I am not a very exalted member of the profession, and the only documentary evidence I can advance as to my standing is a First Class Board of Trade Certificate as engineer in the mercantile marine.

I have lately been given the opportunity of facing an indefinite period of unemployment for reasons which have no present importance, and rather than remain in such an indeterminate state have made repeated efforts to attain that goal, ever present in the eyes of the marine engineer of all ages—a shore job. I have, to a degree, succeeded, and the results have been somewhat staggering.

Hitherto my career has been of the ordinary up-and-down variety, steady sea-going before the war, Royal Naval Reserve during the war, a shore job for some years after the war, and lately back at sea again. In short, I am now at the zenith of an ordinary marine engineer's career—"an old chief."

Since completing my apprenticeship I have consistently kept abreast of the latest developments in engineering science, so far as circumstances permitted, and the reward of diligence in this connection is the same as it would have been if my technical education had ceased on the day I passed the examination for "chief." The fact is there is no reward or other incentive to a marine engineer to widen his knowledge in matters that would, in other branches of the profession, bring him promotion and recognition, with the accompanying status, rewards, &c. The chief engineer's professional reputation, and consequent prospect of continuity of employment, is at the mercy of the whim of the master of his ship. Master mariners are, in most cases, estimable gentlemen, but cannot be considered as final and absolute judges of the professional abilities of any type of engineer. Yet such is the case. In the Navy, the K.R. and A. I prevent anything like an unjust adverse report being made without first communicating the nature of the report to the officer concerned; but in the mercantile marine an engineer's career can be brought to a sudden and unexpected stop by means beyond his control. That is only one of the many reasons why an engineer's life at sea can never hold out sufficient inducement to a man with ideas beyond his station. That, however, Sir, is not my main point.

I mentioned above that I had secured "a shore job," but not as an engineer. I am now a commercial man; a temporary measure perhaps. That, however, remains to be seen.

I am employed by a firm of world-wide repute. I see around me men of only average intelligence achieving success in their job beyond the wildest dreams of a marine engineer. The highest rank in the firm that has honoured me with a job is open to me; and that, in return for a normal exercise of energy, intelligence, honesty and sobriety, not a very impressive array of talents you will admit; and, by the way, I have never had it clearly explained why it is imperative to have the word "sobriety" mentioned in the testimonial every marine engineer must obtain from his employer. Can my brother engineers ashore assure me that it is possible for an engineer, not of sober habits, to succeed in his profession? The only bar to the attainment of such dizzy eminence, for me, is the one I impose on myself—by slacking.

To return to my first love—engineering. I am loth to desert the profession in which I have always been enthusiastically interested. I have been ambitious to attain some eminence. I have repeatedly been interviewed by prospective employers for a shore job, and have—with due modesty I submit the statement—proved to their satisfaction that my education and professional abilities were such as to justify appointment. My diligence in keeping abreast of the ever-changing requirements of the profession has not brought that reward I was taught to expect as a result of industry. I am now within close sight of the forty-five years' mark. I have heard the "too old at forty" cry; I find the age limit is now thirty-five. I can go back to sea if I like, but no thank you, not now. I have tasted some slight measure of success in a commercial career; I have proved to myself how foolish these employers have been in letting a good man slip through their fingers.

To cut a long story short, expressed in terms of £ s. d., I find my value in the labour market increasing daily, so that any prospective employer I might meet in the future will find me asking him to keep the door to executive authority slightly ajar, because unless I find it a bit easier to push open he will be obliged to look elsewhere for an employee.

The question naturally arises: is the profession overcrowded? I think it is, principally by the products of the degree factories set up as a result of the war, where numbers of surviving but misguided patriots were induced to indulge in an intensive cultivation of engineering science.

It will be easy here for any one of these younger men to suggest that old age is having its usual tilt at youth and inexperience and the suggestion will leave me unmoved. When I was younger I was told I lacked experience; I am now considered to be too old, so it does not matter much what is said. What does matter, though, is: I have proved to myself that an engineer of average education is mentally agile enough to adapt himself to new conditions and apply his philosophy of life successfully along a path which, within the profession, is bordered by the sheet-piling of specialisation, clamped firmly together by academic distinction, in order that any superfluous energy he may possess shall be well confined within clearly defined limits.

In this letter I can only discuss an individual case, but you have my assurance, Sir, that there are numbers of men of my own standing and many of superior professional qualifications deserting the profession daily for the reasons discussed here.

Modern conditions in engineering admittedly demand a high standard of education and ability, and British engineering occupies such a prominent place in the world that these standards must be maintained; but is the profession in general making the best possible use of the material at its disposal? This loss in experienced men cannot easily be replaced when required. Our competitors in the field are striving, and in some respects succeeding, to attain that eminence which has been ours by the best development of our resources.

Is there really a superfluity of brains in our profession? If so, I am more than glad to find myself achieving some success outside; if not, I hate to think that I am leaving a field in which I have found pleasure and interest. You will note I am claiming to possess "brains." I do make that claim. They, however, are now for sale to the highest bidder, be what he may. My heart is still in the profession, but my energies are now being reserved to earning a decent livelihood, and incidentally I am now within sight of giving my children that education which I have always hoped to be able to give them—some time.

November 19th. FIRST CLASS B.O.T.

SIR,—When I read your leading article, entitled "The Man and the Job," it seemed to me that you had treated the education of engineers in a very sound way, but knowing how badly we as a nation have got education mania, I was not surprised to read the letter signed "Via Veritas Vita."

Surely your correspondent cannot have examined your article very carefully, for upon reading it again I cannot see where you have even suggested that engineers should not have scientific training; on the contrary, you suggest that their training should be more scientific.

Naturally, if the system of education is to be radically changed, it will upset the curriculum—blessed word!—but future engineers will be launched upon their careers with a much better equipment, and if your correspondent, and others also concerned, would realise that his remarks about inventors being born, not made, equally apply to engineers, then the engineering profession would not be so crowded as it is. Surely, equally important with academic attainments is personality, which, in the case of the engineer, includes, amongst other things, independence of thought, a sense of responsibility and self-reliance, a capacity to get things done, an intense appreciation of practical needs, ability to deduce cause from effect, and to face a new situation without having to consult precedent. These qualifications cannot be taught. Education does not make character, only develops it; and an educated fool is still a fool, though, admittedly, a different kind of fool. The educationalist mind attaches too much importance to the means and not enough to the end.

If your correspondent will read the life of Edison, entitled very appropriately "The Man and His Work," he will find that Edison did not receive a technical education, and in the case of Marconi, it is not what he invented, but through his intense appreciation of practical needs that he has been able to use other people's inventions. Admitting that these and other inventors did not get technical instruction, owing to the lack of the necessary institutions, as your correspondent points out, it was therefore in spite of the lack of this instruction that the world has benefited by their work. Would they have done better had they enjoyed the benefits of the then equivalent technical instruction?

Since there is so much which we must know, and because progress is so rapid, ought we not to discriminate between that knowledge which we require every day and that which is required only occasionally, and develop instead those qualities which will enable us to acquire knowledge ourselves as we go along in after life? We shall then automatically keep ourselves up to date, and if we are able to deduce facts from observations, learn from experience, and apply this knowledge to future work, it will not matter if we failed in higher mathematics when we were young. We shall either use tables or a slide rule.

HAROLD J. KITCHEN.

Richborough, Kent, November 22nd.

SIR,—While appreciating the details contained in "V. V. V.'s" letter, it seems to me that he only skirmishes around the minor details of the case and does not deal with the broad aspects.

Undoubtedly the tendency is as you state in your leading article of November 11th, 1927. Physics, mathematics and chemistry have their uses as preparatory training in public schools and form a good basis. No doubt in the engineering schools the tendency to-day is towards a training which might be termed too much of the academic, and, as your leader states, based to enable the passing of certain examinations, which are usually far from practical in their nature. Engineering facts imparted as far as possible in a practical way, by giving examples on actual average machines and apparatus, are invaluable, and if conveyed to the student in this manner will help him to recognise these principles when presented to him in fresh and often rather obscure guises.

As your leading article states, the clever student in nine cases out of ten does not make good in a way that his examination results would imply, especially so is it the case in the products of the bigger town, where the system of engineering education is based on the ideas of a series of school teachers. To take the L.C.C. for example, how rare it is for an outside man with extensive practical engineering experience in the factory to be appointed to an important post or an inspectorship, yet that is the only type of man who realises, and is able to steer the trend of education in such a manner that the student will be generally useful to the average engineering employer, in whose firm, if he has the grit, he should be able to specialise in a manner that is particularly useful to the branch of engineering in question.

A. P. BALE, A.M.I. Mech. E.

London, November 19th.

SIR,—Your correspondent, "Via Veritas Vita," in your issue of 18th inst., referring to the fact that most of our engineering schools are of relatively recent origin, states that sixty years ago there were only two in the whole of the British Isles, one in London and the other at Glasgow University.

I should like to point out, as a matter of historical interest, that the Engineering School of the University of Dublin was established in 1842, and that the Chair of Civil Engineering was founded in that year. Sixty years ago the school was turning out about twenty men yearly. DAVID CLARK.

Engineering School, Trinity College, Dublin,
November 23rd.

SIR,—As a mechanical engineering draughtsman, age twenty-five, just out of employment owing to trade depression, may I ask your correspondents what other position one could fill satisfactorily. I am not very keen on technical work; that is to say, the memorising and application of formulæ. In other directions I am keen and industrious. H. S.

November 18th.

RAILWAY ACCIDENTS.

SIR,—In my opinion Mr. P. Sedgfield, in your issue of the 4th inst., has done right in directing attention, *inter alia*, to:—(1) The fact that the actual cause of a derailment is not always forthcoming; and (2) the advantage of using compensating levers as a means to lessen, if not entirely to obviate, the chances of derailment.

With reference to the first point, it is perhaps merely begging the question to say that it should not be legitimate to class any derailment as unaccountable, yet, apart from such cases as obstructions on the line, worn flanges, &c., many a derailment has occurred the precise cause of which has been alleged to be unascertainable, and the whole affair has been relegated to the limbo of mysterious and forgotten incidents. This, it seems to me, discloses a very regrettable situation, for if the primary cause of an accident is not discovered, it is obviously impracticable to define and apply a proper remedy.

While in India I had occasion, in my official capacity, to investigate a very large number of derailments, most of which took place on curves. In every case the derailment was found to be due to an unequal distribution of weight on the journals of the wheels. It was my practice to place an Erhardts weighing machine under each wheel in order to ascertain the exact weight on each journal at the time of the accident. In every case I found that the weight on the journal of the wheel which climbed to the top of the rail was not only insufficient to keep the wheel on the rail, but the excess weight carried on the journal of the opposite wheel tended to tilt the outer wheel and thus leave it more or less free to climb the rail. Given a combination favourable to such action climbing will in fact occur. To quote from your leading article of April 14th, 1905, "The leading wheel at the outside of the curve, not being held down, a derailment takes place."

In Great Britain, with what I may call mixed speeds, superelevation is, I know, a matter for compromise, as the amount of cant necessary to counteract centrifugal force and prevent a vehicle capsizing must be arranged to suit the highest speed.

Coming to the question of compensating levers, it has been customary to argue that the use of these contrivances for locomotives in this country is rendered superfluous by the excellent and rigid character of the permanent way. This is no doubt partly true, yet the fact remains that equalisers can be regarded as being of the nature of safety appliances in so far as possible defects in the vehicle and permanent way are concerned. By reducing the liability to derailment, they would, as Mr. Sedgfield implies, anticipate the unexpected. In India for experimental purposes I applied a device of my own to an iron-covered goods wagon, the only fault of which was that it had springs of unequal camber. This wagon was run round a moderate curve of a siding specially constructed with dips and humps in the rails diagonally arranged to suit the wheel base of the vehicle. The wagon minus the device was, of course, thrown off the true, but when its springs were removed and replaced by the device referred to, the vehicle passed over the humps and dips with absolute safety. When the tests, both with and without the device, were repeated the result in each case was the same as before, the wagon with defective springs being derailed, but when fitted with the device it was able safely to traverse the very uneven piece of track in question.

Although it may be admitted that compensating levers are in a comparative sense less necessary here than in other countries where the road is not so rigid, still the question of superelevation has to be reckoned with. Moreover, their use by the Great Western Railway in various types of engines, as mentioned by Mr. F. W. Brewer, seemingly indicates that, from the point of view of load adjustment, there is a distinct advantage in employing them, and all things considered, their wider adoption would surely be a step in the right direction.

Personally, I have no hesitation in asserting that every case of the flange of a wheel being able to climb to the top of the rail is entirely due to a defect in the vehicle, as it is only absence of weight that allows climbing to take place.

London, S.E. 4, November 17th. JOHN RIEKIE.

WHITWORTH SCHOLARSHIPS.—The Board of Education announces that the number of competitors at this year's examination for Whitworth Senior Scholarships was ten, and for Whitworth Scholarships eighty-seven, and that the following were the successful candidates:—For Whitworth Senior Scholarships of an annual value of £250, tenable for two years: Arnold W. Morley, 21, student (late engine fitter apprentice, H.M. Dockyard, Chatham); and William Cowen, 23, student (late apprentice mechanic, Burnley). Honourable mention, none. For Whitworth Scholarships of an annual value of £125, tenable for three years, the following were successful:—Ernest F. Byng, 19, electrical fitter apprentice (H.M. Dockyard, Portsmouth); Herbert W. Thomas, 18, electrical fitter apprentice (H.M. Dockyard, Portsmouth); Charles S. Hudson, 20, student (late ship fitter apprentice, H.M. Dockyard, Chatham); Donald J. Fee, 19, electrical fitter apprentice (H.M. Dockyard, Portsmouth); Frederick W. J. Sainsbury, 19, electrical fitter apprentice (H.M. Dockyard, Devonport); and Harry G. Rhoden, 20, apprentice fitter (Wigan). Twenty-five unsuccessful competitors for Whitworth Scholarships were awarded Whitworth Prizes of the value of £10 each.

THE EMPIRE COUNCIL OF MINING AND METALLURGICAL INSTITUTIONS.—To round off the very successful Mining and Metallurgical Congress which was held in Canada in August and September, and of which reports are still appearing in our columns, a banquet was given on Tuesday evening, November 22nd, to Mr. Peter Larkin, the High Commissioner for Canada, and Sir Robert Horne, the President of the Congress. The chair was taken by Sir Thomas Holland. Sir Robert Horne, when proposing the toast of "The Dominion of Canada," referred to American investments in that Dominion. He said that he did not look upon them with any uneasiness, though he regretted that it was impossible for Great Britain to invest as freely. But when one considered the vast resources of Canada, it was better that they should be developed by American capital than not at all. Sir Peter Larkin acknowledged the toast very briefly. Lord Lovat proposed "The Mineral and Metal Industries of the British Empire." He dwelt upon the value of congresses in bringing men together. Lord Greenway, who responded, put forward a scheme for the improvement of the coal industry. It may be briefly described, in his own words, as "trustification by districts." Sir Auckland Geddes replied in a brilliant speech, in which he deprecated the continual appeal to the conditions provoked by the war as an explanation industrial difficulties. He thought it was time that Great Br forgot the war and braced itself to meet a new world o perity and development. Sir William Larke also rea the toast and took the opportunity to refer to t rationalisation in the iron and steel industries.

Commercial Motor Vehicle Exhibition at Olympia.

No. II.*

Producer Gas Propelled Vehicles.

Although the prospects of the producer gas propelled vehicle are not very bright in countries where liquid fuels are to be obtained at reasonable prices, there are still many parts of the globe where such amenities of civilisation are not yet available, but where fuel in the form of wood and such vegetable refuse as maize cobs, nut shells, cotton seed, rice or padi-husk can be obtained in profusion. All of these can be converted into a combustible gas.

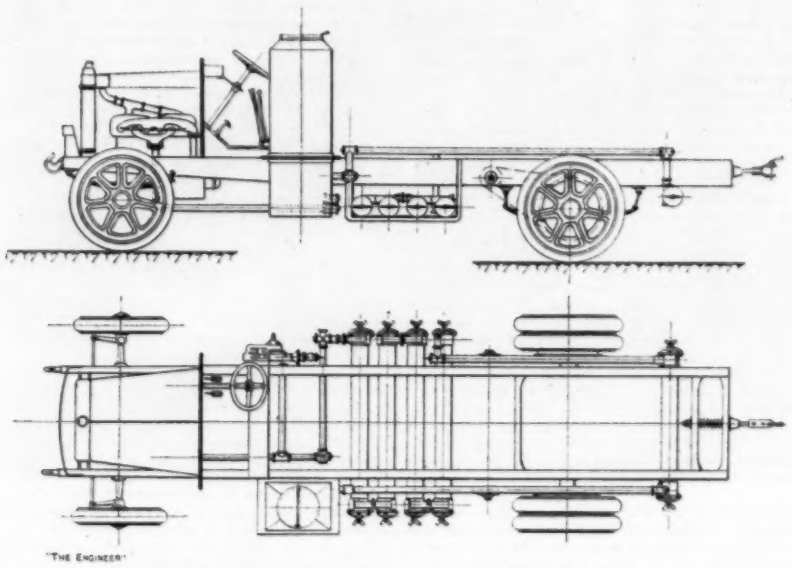

FIG. 8—CHASSIS FITTED WITH GAS PRODUCER—BERLIET

Raw wood is one of the best fuels for the purpose, and several motor vehicles are on view at Olympia fitted with gas producers designed to burn wood. One of them, called the "Compound" gas producer, is shown fitted to a six-wheeled lorry built by Karrier Motors, Ltd., Huddersfield, and fitted with winch gearing. The "Compound" producer is remarkable for the small amount of space which it takes up. It is attached to the side frame of the machine and is fed from a hopper placed over the driver's cab. In this producer the products of combustion forming the gas are passed through two grates of different sizes and are twice exposed to the concentrated heat of the fire by which, it is claimed, all the volatile matters contained in the fuel are eliminated, leaving a clean dry gas containing only a small proportion of dust, which is easily removed in the cleaner or scrubber. There are no moving parts in this producer, which has only one pipe connection, namely, that to the engine. The scrubber is combined with the producer which it surrounds. The air supply is taken down through a casing between the scrubber and the combustion chamber and arrives at the fire in a warm condition, while the gas is cooled by the same process.

A feature of this producer is the absence of the usual hand blower for starting up, which is claimed to be unnecessary. Neither is any alteration of the engine required when it is desired to fit a producer other than the advancing of the magneto. The petrol carburetter and fittings are retained and can be used either for starting up or for use in emergency. An automatic spring-loaded air valve is fitted on the gas pipe between the producer and the engine, and also a hand-controlled air valve within reach of the driver. The foot accelerator is connected to the gas throttle valve and the vehicle is controlled in the usual way. Gas is produced only while the engine is running, and it is claimed that no storage cylinders are required. As the suction through the producer is downward the fuel can be replenished while the plant is in operation. We understand that patents are pending for this plant.

Other exhibits of gas producer driven vehicles are those of Panhard and Levassor, Great Portland-street, W. 1; and Automobiles M. Berliet, Lyons and Twickenham. The latter showed a vehicle—Fig. 8—with a producer similar to that fitted to a road roller by Barford and Perkins, which we described last week in connection with the Road Transport Exhibition. Messrs. Panhard and Levassor's producer is composed of four elements—a generator, cooler, purifier, and a mixer. The generator, cooler, and purifier form a single unit carried on a false chassis articulated to the main chassis so as to avoid breakage of the gas joints and hence the admission of air. The generator consists of a sheet iron vertical cylinder fitted with a refractory lining and the upper part forms a hopper which contains the supply of fuel—charcoal—which is supplied to the furnace through the bottom of the hopper by a cone-shaped deflector around which the air for combustion circulates. The air passes between the two external walls of the generator, where it is raised in temperature and at the same time cools the wall of the producer. The gas passes to the cooler, which comprises a double row of pipes under the chassis and forms the passage for the gas to the purifier. The latter works on the dry system, the gases passing from the bottom to the top through a bed of coke and afterwards pass through a filter which collects the dust, on their way to the mixing apparatus. The mixer is a three-way cock fitted on the engine, communicating on one side with the carburetter and on the other with a two-branched tube, one of which introduces the gas from the generator and the other the air. A valve actuated by the accelerator pedal controls the admission of the mixture. A fan is used for starting purposes and the engine is started on petrol. The cleaning of the purifier is a simple matter; all that is necessary is to take out the filter and turn it upside down. Three sizes of vehicle made by this firm are fitted with producers; the largest in running order weighs 7 tons 17 cwt. It has a four-cylinder engine, 105 mm. bore by 110 mm. stroke, and has steel sleeve valves lined with anti-friction metal.

* No. I. appeared November 18th.

Dennis Bros., Ltd.

Dennis Bros., Ltd., of Guildford, are exhibiting a 70 horse-power low-loadline parlour coach of pleasing appearance, which is illustrated in Fig. 9. The four-cylinder engine has a bore and stroke of 110 mm. by 150 mm. respectively, and the cylinders are cast *en bloc*. Side valves are employed and the detachable cylinder head is in two halves. The ignition is by magneto and the petrol is fed to the carburetter by vacuum tank from a 30-gallon tank situated nearly amidships on the offside of the chassis. The drive is taken through a Ferodo-lined external cone clutch to a right-hand controlled four-speed gear-box. The final drive is by open propeller shaft to an underslung rear axle. Internal expanding servo-operated four-wheel brakes actuated by the foot pedal are fitted, the hand brake operating on separate shoes in the rear wheels only. The top of the frame is 2ft. 2½in. from the ground and the chassis weighs some 60 cwt.; 36in. by 6in. tires are fitted, singles on the front and twins on the rear wheels. A feature of this exhibit is the excellent body work.

FIG. 9—70 H.P. LOW LOAD-LINE PARLOUR COACH—DENNIS BROTHERS

Karrier Motors, Ltd.

Karrier Motors, Ltd., of Huddersfield, is exhibiting a new six-wheel chassis—Fig. 10—which is attracting a considerable amount of attention. The six-cylinder engine—Figs. 11 and 12—is of entirely new design. It is of the single sleeve valve type and is built under Burt-McCollum patents. The sleeves, which are of cast iron, have a rotary as well as a reciprocating motion and are operated by cranks, the latter being driven through worm gearing from the lay shaft. The latter, which is formed in two halves bolted together at the centre, is carried in nine white metal bearings and is permanently submerged in oil. The cylinders are cast *en bloc* and have a bore and stroke of 105 mm. and 150 mm. respectively, giving a capacity of 7·8 litres and an R.A.C. rating of 40·09 H.P. A compression ratio of 5·3 to 1 is employed and the makers claim that the engine develops 63 B.H.P. at 1000 r.p.m., 98 B.H.P. at 1600 r.p.m., and 116 B.H.P. at 2200 r.p.m. Aluminium alloy pistons having domed tops are used, and the connecting-rods are of duralumin. The combustion spaces in the detachable cylinder head are conical, and the sparking plugs are centrally placed. Secured to the head by means of the sparking plug caps is a water jacket, and the sleeves work between two water-cooled surfaces around the ports where the heat is the greatest.

The crank shaft is formed in two halves with the fly-wheel between the flanges at the inner of the halves, these parts being spigoted together and secured by six bolts. The crank shaft is machined from the solid and is carried in ten white metal bearings. Forced lubrication is employed on the dry sump system. Two plunger type pumps driven from the crank shaft are arranged in the top half of the crank case and draw oil from a 5-gallon tank situated on the dash. The oil is then fed under pressure to the hollow lay shaft operating the sleeves, through drilled passages in the crank case to the big end bearings and thence through the drilled crank shaft to the big ends. Splash lubrication is relied upon for the sleeves and little ends.

Before the oil is returned to the dash tank it is passed through an oil cooler situated on the offside of the cylinder block. This cooler consists of a cast aluminium casing in halves containing a rotary paddle, and the oil after passing through it is forced through a large filter which is secured to the dash. Two relief valves are employed on the oiling system, one being for the delivery side of the pump and one for the general system.

The magneto and centrifugal water pump are placed on the near side and driven by a silent chain from the centre of the lay shaft, the adjustment of this chain being effected by rocking the magneto. A novel form of coupling is used between the magneto and water pump. It consists of a chain meshing with two sprockets slightly out of centre. In this way the rocking of the magneto does not alter the distance between the centres of these sprockets, but merely the relative positions of the centres.

Two exhaust manifolds, which are connected to a single pipe at the front and rear of the cylinder block, are provided. Carburation is afforded by a single Stromberg carburetter which is bolted to the cylinder block, the mixture being conducted through passages in the cylinder walls and the gases being deflected to each port. The self-starter is neatly housed on the offside of the crank case and operates upon the central fly-wheel. The C.A.V. dynamo is placed in rather an unusual position on top of the cylinder head. It is insulated from the heat by an asbestos mat and driven by twin belts from the fan. A similar pair of belts

convey the drive to the fan from the front end of the lay shaft, the fan being mounted on an excentric spindle.

The clutch is of the single plate type and its weight

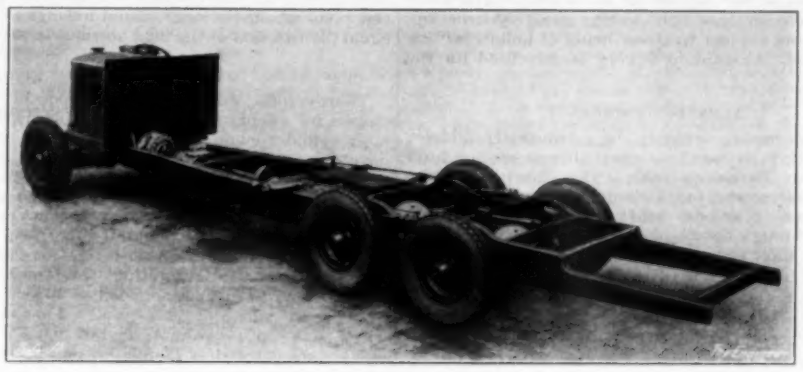

FIG. 10—SIX-CYLINDER SLEEVE VALVE ENGINED CHASSIS—KARRIER

has been considerably reduced by employing duralumin castings. It is air cooled, air being sucked in through the casing—the clutch plate being vaned—into the centre of the clutch and expelled through

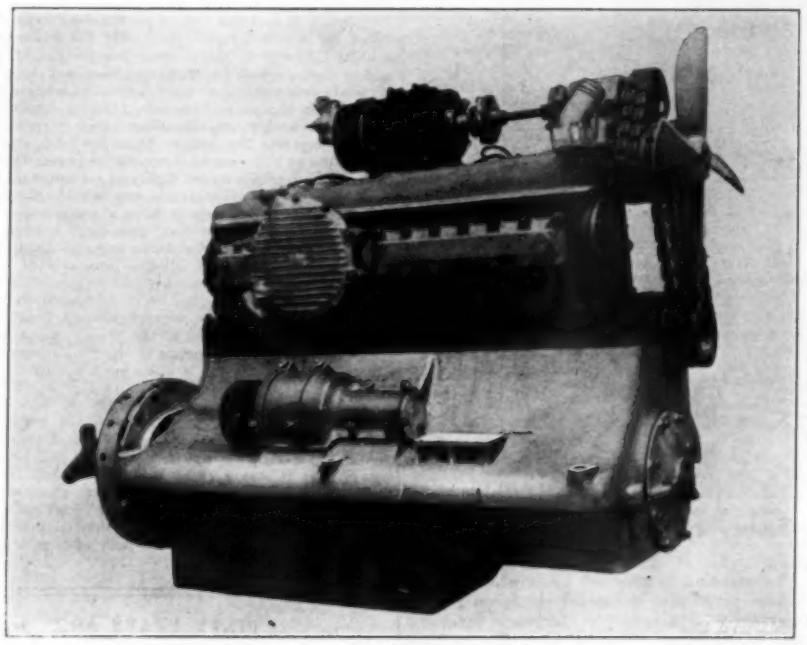

FIG. 11—SIX-CYLINDER SLEEVE VALVE ENGINE—KARRIER

holes in the casing. The clutch shaft is carried in two self-aligning Skefko bearings, one in the crank shaft and one in the flexible coupling between the clutch and gear-box. A clutch stop is fitted. Both the cross shaft for the clutch withdrawal gear and the brake cross shafts are mounted in spherical bearings.

The gear-box provides four forward speeds and a reverse. The chassis is arranged for forward control and the gate for the change-speed lever is mounted on a facing on the offside of the engine. The engine, clutch, and gear-box are mounted on a sub-frame and supported at three points, it being only necessary to undo three bolts to permit the removal of the entire sub-frame without disturbing the gear-box controls. A transmission brake operated by the hand lever is situated behind the gear-box and is of the internal expanding type. The brake drum is 16in. in diameter and the shoes are 3in. wide. The final drive is by cardan shaft, having a flexible coupling at either end and ball centring devices to the transmission brake, the latter being housed in a stout tubular cross member. From there the drive is taken by a propeller shaft having metal universal joints to the forward rear axle.

Underslung worm-driven rear axles are used, and the pressed steel axle casings are of the banjo pattern. A cardan shaft having universal joints at either end connects the rear end of the forward axle worm shaft with the front end of the rear axle worm shaft. The rear bogie is fitted with two pairs of semi-elliptic springs, each pair being free to swivel on a central fulcrum bracket attached to the frame. The springs have positive endwise location and excessive axle movement is restricted by means of bumper pads. The frame is of deep section and the height of the top of the frame from the ground when loaded is 2ft. 1in. Each side member encircles the axles and is pressed out in banjo form to allow for axle movement and also for axle withdrawal when necessary. The rear portion of the frame is dropped to a height of 1ft. 8½in. from the ground when loaded. Pneumatic pressure brakes of the internal expanding type are fitted to all four driving wheels and are operated by a foot pedal. The air reservoir is mounted on the offside of the frame and is charged by a gear-driven pump situated on the near side of the engine. In the event of trouble with the air supply the brakes can be mechanically operated by the same foot pedal. An attachment is fitted to the air reservoir for inflating the tires. Detachable disc wheels and 36in. by 8in. pneumatic tires are fitted all round.

The petrol feed is by Autovac from two separately-

FIG. 12—SLEEVE VALVE ENGINE UNITS—KARRIER

mounted 26-gallon petrol tanks. These tanks are arranged inside the chassis frame, one on each side, and joined together by a flexible pipe. They may be used separately or together, and both are filled from the near side of the chassis, and a petrol gauge is fitted to each tank. The steering gear is of the cam and nut type and the chassis has a turning circle of 60ft. The weight of the chassis is 4 tons 8 cwt.

Kirkstall Forge Four-wheel Drive.

On the stand of the Kirkstall Forge, Ltd., Leeds, we were shown what at first sight seemed to be a four-wheel driven bogie of the subsidy type, but on looking further into the details, we noted one very distinct departure from conventional practice in six-wheel vehicle design. The exhibit to which we refer is intended for passenger vehicles, as distinct from those for use over rough country or for colonial or War Office purposes. The makers state that, for what may be called the finer uses, something rather different is required to overcome the disadvantages of a drive constructed to operate over rough country. These disadvantages are summed up as follows:—(1) Both rear axles are driven at the same speed, and should the tires on one axle not be exactly the same diameter as the tires on the other axle, owing to the different inflation pressures, type of tire or wear, it is obvious that slip between the tire and the road must take place, with excessive wear; (2) under some conditions it is possible for the whole of the driving effort to be transmitted through one axle only, and the axles must therefore be made sufficiently strong to take that load, which means unnecessary weight and expense; (3) in the event of a breakage occurring in the driving mechanism of one axle, extra load is put upon the other axle, which usually collapses also. In order to overcome these disadvantages, an extra differential is embodied in the foremost axle to balance the drives to the two axles. This enables each road wheel to run at the correct speed to suit its diameter, which eliminates tire slip, and considerably prolongs the life of the tires. Moreover, with this construction it is impossible for either axle to transmit more than half the total engine torque, and the parts can be made correspondingly lighter. Should a breakage of the driving mechanism of one axle occur, the second axle is not affected. The extra differential is built into the foremost worm casing, and is in direct communication with the main oil sump, and hence runs continuously in oil.

Walker Brothers Six-cylinder Chassis.

Features of novelty are to be seen in the low-loading omnibus chassis exhibited for the first time by Walker Brothers (Wigan), Ltd. This chassis has a six-cylinder engine with cylinders 95 mm. by 140 mm. and 33·5 horse-power according to Treasury rating. One of the special features of the chassis is the mounting of the engine and radiator on a separate underframe suspended at three points from the main frame, so that the underframe complete with the engine and radiator can be withdrawn at the front end by the removal of four bolts holding the frame, though, of course, it is also necessary to uncouple the clutch and carburetter controls and the exhaust, oil and petrol pipes. Even so, the whole operation can be carried out in about half an hour. The sub-frame is fitted in front with a single central trunnion, and the rear ends are bolted down on top of the second cross member, which is secured below the main side channels. To the outside of each side frame channel are fixed two short brackets, to which are pivoted short levers fitted with rollers at the lower ends. These levers lie normally at an angle, so that the rollers are clear of the lower flanges of the main frame. The two pairs of levers are linked together by rods which have extensions to engage with nuts carried in fixed brackets. The rods have squared ends, so that they can be turned and thus bring the pivoted levers into a vertical position, and the rollers into contact with the main frame flanges, which raises the sub-frame. The weight of the whole is then carried on the rollers and the whole unit can be drawn forward on to a trestle or stand, where the parts are all ready for inspection. The gear-box can also be dropped from the frame without disturbing the body or floor boards. The rear axle is of the underslung worm pattern. The engine of this omnibus, which is intended to carry thirty-two passengers, develops 75 brake horse-power at 2000 revolutions per minute.

British Mercedes Six-wheel Chassis.

A new departure, shown by British Mercedes, Ltd., Long-acre, London, is a 5-ton chassis with six wheels, fitted with a crude oil engine of 70 horse-power. The engine has four cylinders, 105 mm. bore by 165 mm. stroke, and will operate on paraffin, gas, oil or the usual varieties of crude oil.

Bristol Omnibuses.

The products of the Bristol Tramways and Carriage Company, Ltd., have achieved a high reputation for workmanship and reliability in service, and an inspection of the firm's exhibits tends to confirm the good reports of their users. At Olympia this company is showing a thirty-two-seater "super-bus," a twenty-six-seater all-weather coach, and a twenty-seater omnibus. The thirty-two-seater is mounted on a low loading light passenger chassis of the half-bonnet type, which gives complete accessibility to the engine, all the valves, magneto and carburetter being adjusted from the near side. The engine has four cylinders, 4½in. bore by 5½in. stroke, with R.A.C. rating of 32·4 horse-power, and it is capable of developing 75 brake horse-power at 2000 revolutions per minute. Four-wheel brakes are provided, the foot brakes being

applied through Dewandre vacuum servo, and all the road springs are fitted with this firm's patented device which permits automatic adjustment for varying loads with a high overload capacity. The unladen weight of this chassis is 2 tons 16 cwt., and the wheel base is 15ft. 7in. The chassis is equipped with rubber buffer vibration-absorbing body attachments, by which means the body is entirely insulated from the chassis. The twenty-seater omnibus has a four-cylinder engine, rated at 25·6 horse-power, but capable of developing 50 brake horse-power.

Garrett Six-wheel Electric Trolley Omnibus.

One of the exhibits of Richard Garrett and Sons, Ltd., is a rigid six-wheel electric trolley omnibus mounted on pressed steel wheels, shod with pneumatic tires—Fig. 13. The vehicle is propelled by means of a single 60 horse-power motor, arranged for series-parallel control, and has a top speed of 1060 r.p.m. at one hour rating, in accordance with the B.E.S.A. Specification. The makers claim that the commutator is absolutely sparkless at any load up to 250 ampères. The two rear axles are driven in tandem by a common propeller shaft, and the rear

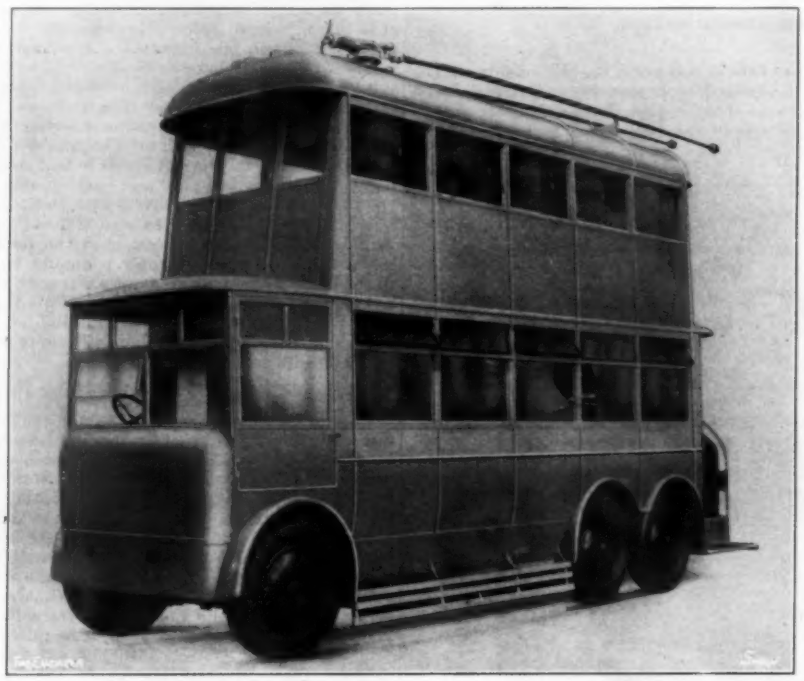

FIG. 13—SIX-WHEEL ELECTRIC TROLLEY OMNIBUS—GARRETT

suspension is effected by two inverted semi-elliptic rear springs, working in conjunction with two radius rods. The pivot of the rear springs lies in a horizontal line with the centre of the rear wheels. A ten-speed forward and reverse "Garrett" controller with shunt field controlling gear is fitted, and there is a special device to enable the controller to return to the "off" position as soon as the brakes are released. A foot brake operates on the front wheels, and on one set of the rear wheels. A hand brake operates on the remaining pair of rear wheels. A Westinghouse air brake equipment is connected to the foot brake. The body is a double-deck, with a covered top saloon, and it accommodates twenty-eight people in the lower saloon and twenty-seven people in the upper saloon. The bodywork is of composite metal type, the whole of the framework and panelling being of steel, mostly spot welded in complete sections, wood being only used for the convenience of fitting, as in window frames, &c. The upholstery is carried out in real leather of antique pattern, and the lighting and fitting arrangements are in accordance with best omnibus practice. Messrs. Garrett are also exhibiting an improved rigid six-wheeled undertype steam wagon for carrying loads up to 10 tons.

Associated Daimler Company's Exhibit.

Four typical vehicles are shown by the Associated Daimler Company, including a thirty-four-seater single-deck saloon omnibus, a sixty-eight-seater six-wheeled double-deck covered-top omnibus, a light passenger chassis with a six-cylinder sleeve valve engine, and a 30-cwt. commercial chassis. The chassis of the thirty-four-seater saloon omnibus is an entirely new production, and its weight has been reduced to the minimum by the use of high-tensile aluminium alloys. The chassis is equipped with a 40–70 horse-power six-cylinder Daimler engine, with cylinders 81·5 mm. bore by 114 mm. stroke, four-wheel vacuum servo brakes and "one shot" lubrication. The body is also of light weight, aluminium being used for the panels, roof ends, window frames and interior fittings. The entrance is at the rear, and it is furnished with sliding doors. The sixty-eight-seater omnibus has six road wheels and a double deck, with a covered top. A special feature of the ground. The steering is effected by a wheel acting through helical gears and universal joints on a spur pinion engaging with a semi-circular rack attached to the centre of the frame. The track of this machine is 5ft., the wheel base 7ft. 7in., and the turning circle 30ft. The tractor weighs 3 tons 14 cwt. and the normal top speed is 10 miles per hour.

Citroen, Commer, and Crossley.

One of the attractions of the Citroën stand is a Citroën-Kegresse car with a new type of endless band attachment with studs in the band which mesh with holes in the driving pulleys. This machine has a two-speed driving axle gear operated from the driver's seat, giving six forward speeds and two reverse speeds. Amongst the exhibits of the Commer Company is a thirty-two-seater omnibus with rigid six-wheel drive. A low-loading refuse collecting vehicle with hydraulic tipping gear to carry a load of 2 tons is also shown. Crossley Motors, Ltd., exhibit, amongst other vehicles, a medium type rigid six-wheeler. This machine is built in accordance with the W.D. subsidy requirements and has an engine rated at 25·6 horse-power.

Mercedes and Scammell.

One of the real novelties of the Show is on the Mercedes stand and consists of a Mercedes-Benz 5-ton chassis. It is equipped with a six-cylinder Diesel engine with a bore and stroke of 105 mm. by 165 mm. respectively, developing 80 brake horse-power at 1300 revolutions per minute. We understand that the makers have had considerable experience with this type of engine and have every confidence in placing it in the hands of users of this class of vehicle. The engine operates on the four-stroke principle and is started up by an electric motor. There is also an electric device for heating up a plug to facilitate ignition of the charge. Two exhibits which are quite out of the ordinary run of commercial vehicles are to be seen on the stand of Scammell Lorries, Ltd., Holborn, London. One is a 4–6-ton rigid six-wheeled chassis with a special pivoted front axle carried on a transverse spring and an articulated rear axle with worm-driven differential and spur gear drive to all four wheels. This articulation is effected by means of a massive steel bracket to each pair of wheels which can swivel about the rear axle casing and gives a very free movement in one plane. The eight-wheeled machine embraces a carrier of new design. It has two short axles in line and each of these axles carries two road wheels between which and below the axles leaf springs are provided. The arrangement of the springs is such that each axle can pivot about its longitudinal axis, thus giving an equal distribution of the load on the wheels.

Thornycroft.

Thornycrofts exhibit a new type of passenger chassis for twenty-seater bodies, which is fitted with a six-cylinder engine, 3¾in. bore by 5¼in. stroke and developing 60 brake horse-power at 1500 revolutions per minute. This engine has detachable cylinder barrels, a seven-bearing crank shaft, and the engine and gear-box form one unit suspended at three points. There is a single-plate clutch, four-speed gear-box, and the final transmission is by an overhead worm. This firm is also exhibiting three subsidy type vehicles, one to carry a net load of 30 cwt., a second to carry a net load of 2 tons, and a 2–3-ton rigid six-wheel chassis of remarkable flexibility. The engine of this chassis is rated at 22·5 horse-power. It has four cylinders, 3¾in. bore by 5in. stroke. The suspension of the rear bogie complies with the W.D. specification and has been patented by the makers. The rear suspension permits 12in. difference in the driving axle levels and allows either axle to tilt to an angle of 18 deg.

THE NILE.

"The Nile and the Use of its Waters," was the subject taken by Sir Murdoch Macdonald for his recent Presidential address to the Junior Institution of Engineers, and in that address Sir Murdoch described the possibilities of land reclamation and irrigation improvements which still exist in Egypt, and explained the constructional works at present under consideration. One proposal, he said, was to heighten the Assuan Dam by 7 m., and so far as stability was concerned, it would be perfectly safe. The Gebel Aulia site for a new dam and reservoir on the White Nile just beyond Khartoum was an excellent position, and a relatively low dam built on the sandstone formation would be capable of keeping in a large volume of water. Other suggested sites for dams were at Lake Tsana and Lake Albert. To meet all the demands of Upper and Lower Egypt for reclamation and irrigation, the summer supply of the river needed to be increased to about 1500 tons per second, with correspondingly greater volumes during the other periods of the year. Account had also to be taken of developments in the Sudan, but the Sudan area was too restricted to take such a quantity of water from the Blue Nile as would hurt Egypt. Sir Murdoch said that there was conjoined with all these works and others which might yet be suggested a political aspect, but if the builders of all or any of them did not forget the rule that the right of first user to water could not be taken away, that it was a right which could not be separated from the property to which it applied, then justice would be done in the distribution of water to all the inhabitants of the Nile Valley, and the immemorial position in this respect of Egypt in the lower part of that Valley would be fully conserved.

SIXTY YEARS AGO.

To-day and for a number of years past it has been forbidden to us, or at any rate made impossible, to describe in detail the construction of new British warships. There was a time when it was greatly otherwise. In our issue of November 22nd, 1867, for example, we find an article giving intimate particulars of the hull, armament and machinery of her Majesty's ironclad ship Hercules. It was but the other day, we wrote—actually, it was a matter of ten years or so—since the heart of the nation had stirred at the first sight of the Warrior as she floated in Hamoaze, a champion ship ready to do battle with all comers. Science, however, had progressed, and already the "dainty" Warrior with her "enormous" dimensions, her impregnability and her high speed was a ship of the past. In naval circles the Hercules was exciting as much, or nearly as much, attention at the moment as the Warrior did in her day. That vessel, designed by Mr. E. J. Reed, the Chief Constructor of the Navy, had been laid down at Chatham in 1866, and was at the date on which we wrote fast approaching the launching stage. Mr. Reed's genius and abilities had, we said, often been disputed, but it could not be denied that in designing the Hercules he had displayed talent of a very high order. She was described as being defensively and offensively the most powerful naval ship the world had ever seen. Her dimensions were comparable with those of a modern light cruiser. She had a length of 337ft., a beam of 70ft. 6in., and mean draught of 24ft. 10in., and a displacement of 5226 tons. The skin of the hull was composed of 1¼in. iron plates, outside which there was a 12in. layer of teak, serving as backing to iron armour plate 8in. or 9in. thick. Inside the skin there were three layers of teak, having a total thickness of about 28in., and, finally, a second skin of ¾in. plate. The vessel was designed to carry an "enormous" spread of canvas, for much was hoped from her as a sailing ship. She was equipped with a pair of trunk engines, made by John Penn, developing about 7000 horse-power, with steam at a boiler pressure of 30 lb. Her designed speed was 14 knots. In her bunkers she could carry 600 tons of coal or sufficient for 2½ days' consumption at full power. Her armament consisted of eight 18-ton guns, mounted, four on each side, in a central casemate, two 12-ton guns on the main deck, and four 6½-ton guns on the upper deck. The bow and stern guns of the casemate battery on each side could be withdrawn from their broadside ports and discharged through indented ports forward or aft respectively at an angle of 15 deg. to the keel line.

Railway Matters.

THE Great Western Railway has agreed to award cash prizes, in respect of each engineering department division, to the ganger, sub-ganger, and undermen—platelayers—of the gang whose length is adjudged to have been kept in the best condition during the preceding twelve months. The prizes are as follows:—Ganger, £5; sub-ganger, £3; each underman, £2.

THE difficulty which the coroner's jury, which inquired into the cause of the Sevenoaks railway disaster, had in allocating the responsibility for that derailment prompts the remark that only once during the twenty-five years 1900–1924 did a Government Inspector, after inquiring into a derailment, report that he could not find any reason for the accident. That single instance occurred at Wickham, on the Great Eastern Railway, on November 16th, 1905. In the twenty-five years 1875–1899 there were seven such unexplained cases.

IN this column of our issues of November 11th and 18th mention was made of the good work done by the local conferences of traders and railway officials. That subject must now again be referred to in order to say that a meeting of representatives of the traders' panels of the local conferences has recently been held at the offices of the Association of British Chambers of Commerce, when testimony was paid to the valuable aid of the conferences to settle local difficulties, and a resolution was passed recommending their recognition of the Railway Rates Tribunal.

THE Southern Railway has installed as an experiment a number of loud speakers on the down platforms Nos. 6 and 7 at the high-level, eastern section, station, London Bridge. They are operated from a close-talking transmitter used on a power amplifier in signal-box A and advise waiting passengers as to the destination of an approaching train, from which platform it will start and at what stations it will call. There are five loud speakers on each platform and two in a central position. The latter are used for all trains, but each set of five is only employed for a train that calls at that particular platform.

THE Vienna correspondent of *The Times*, telegraphing on November 17th, says that great surprise and disappointment are felt in Austria at the decision of the authorities to proceed no further with the electrification programme of the Austrian State Railways, and to utilise the remainder of the funds, set aside for this purpose out of the international loan, for other purposes. The discovery has been made, it is stated, that those portions of the electric railways now under operation are working at a financial disadvantage as compared with those under steam traction. All the initial calculations are now found to be inaccurate.

THE compulsory advertisements of the Parliamentary notices of the Railway Bills for next session show that the four grouped companies and the Metropolitan have lodged identical Bills seeking for powers to "provide, own, work, and use road vehicles . . . for the conveyance of traffic of all descriptions," and to "enable the company and any local authorities, company, body or person to enter into and carry into effect agreements with reference to the working, use and supply of road vehicles." The two companies which have lines in Scotland have given notice of their intention to petition for a Scottish Order for similar powers in Scotland.

EXCEPTIONAL rates, to cover large consignments of traffic or other such conditions that warranted special treatment for traders, have been unusually numerous; under the new scale of charges operative at the New Year they will be literally exceptional and by no means as general as to-day. With a view to a further reduction in their number it has been agreed between the large trading organisations that those within 5 per cent. of the standard shall be raised to the standard. Those which are 5 per cent. or more below the standard but not more than 40 per cent. below are to be entered in the rate books as actual chargeable figures. Those 40 per cent. or more below have, in accordance with the Act, to be referred to the Railway Rates Tribunal for authority to continue.

IN an interview with a press representative, possibly on his assuming to office of chairman as well as president of the executive, London, Midland and Scottish Railway, Sir Josiah Stamp made several observations, but none that was new. What Sir Josiah said as to electrification was in accordance with known fact, but as the railway companies' case, in that respect, was very well put, we think it may be of interest to note that he observed that it would be a long time before the electrification of long-distance main line traffic could be justified. Some people had the idea that it was easy to take electricity to any point for the running of the railway services. Though that might be true from an engineering point of view, in other ways it was far from being the fact. The cost of distribution of current and of the provision of new rolling stock to replace that which electrification made obsolete were two main factors which had to be considered in relation to any economic scheme.

ACCORDING to the Board of Trade returns the value of the railway material exported during the first nine months of the present year was as follows; the corresponding figures for 1926 and 1925 are added in brackets:—Locomotives, £1,464,012 (£2,525,335, £2,184,503); rails, £2,354,946 (£1,287,387, £1,456,600); carriages, £2,457,703 (£2,206,039, £1,148,307); wagons, £2,123,451 (£2,329,251, £2,545,456); wheels and axles, £553,080 (£369,172, £452,842); tires and axles, £466,875 (£221,304, £320,609); chairs and metal sleepers, £981,160 (£611,153, £686,465); miscellaneous permanent way, £1,137,311 (£850,727, £1,005,551); total permanent way, £5,705,175 (£3,485,572, £4,067,738). The weight of the rails exported was 287,773 tons (160,359 tons, 154,616 tons), and of the chairs and metal sleepers 98,194 tons (62,988 tons, 61,390 tons). During the month of September last the locomotives shipped were of the value of £238,121, and included:—Other countries than the Argentine in South America, £88,462; India, £67,617; Straits Settlements, £20,043; Ceylon, £14,130; Australia, £2852. The rails sent overseas in September were of the value of £445,262, and included:—India, £150,699; the Argentine, £125,533; Portuguese East Africa, £24,674; British West Africa, £20,693; Chile, £9854; South Africa, £7931; Ceylon, £4814; Straits Settlements, £3980; Australia, £1796.

Notes and Memoranda.

IT is suggested in the *Iron Age* that if deep tanks were made of plates tapered in thickness, in a vertical direction, welded together, a saving of about 20 per cent. in weight of metal could be made, as compared with the usual practice of building tanks in rings of plates of different thicknesses.

A RATHER unusual type of explosion accident is recounted in a recent official report. It concerned a steam heated keir. Usually the joint of the cover was made with a gasket of thick hemp cordage, which was so unyielding that a tight joint could never be made until on the occasion of the accident some softer material was used. The steam pressure accumulated and caused the failure of the keir.

A TEST was made just before the recent opening of the new Holland tunnels under the Hudson River, New York, to prove the effectiveness of the fire-fighting equipment. An old motor car was driven unto the tunnel and saturated with petrol. It was set alight, and the petrol tank was punctured, so that the petrol ran out on to the roadway. The fire was attacked with four 5-gallon Foamite extinguishers, and was put out in 3½ minutes. The smoke produced caused no inconvenience to the bystanders.

THE complete collapse of a Scotch boiler on a small cargo steamer was caused by shortness of water, which is accounted for by the engineer blowing down under the impression that the high water showing in the gauge glass was reliable. Subsequent investigation showed that the handle of one of the gauge cocks was twisted, and that when the cock appeared to be open it was really shut. It was in that position at the time of the accident, and the gauge was consequently inoperative. The accident is a striking example of the necessity for frequently testing the working of water gauges.

A MINOR explosion was caused on a steam wagon, working in Liverpool, through the screwed end of a stop-cock plug breaking off and the plug blowing out. In his comments on the mishap the Engineer Surveyor-in-Chief says:—"The cocks fitted to this type of boiler are necessarily small, and consequently safeguards cannot so readily be embodied in the design to prevent the plugs blowing out in certain circumstances. Such cocks and other mountings therefore should, when exposed, during stoking operations, to the danger of blows from firing tools or lumps of coal, be suitably protected to prevent damage and consequent injury to the attendants."

WHAT the manufacturer calls the largest motor generator type of electric locomotive in the world, one of four being built by the General Electric Company for the Great Northern Railway for hauling passenger and goods trains through the new 8-mile tunnel piercing the Cascade Mountains, is being exhibited during October at cities along the Great Northern road. The locomotive has been so designed that speeds up to 50 miles an hour may be attained without interfering with good riding qualities. Within its cab is a travelling sub-station taking 11,000-volt alternating current from the overhead trolley wire and changing it to low-voltage direct current for operating the driving motors.

IN an article in the *Engineering News-Record* on the effect of ice thrust on dams it is stated that the expansion of a sheet of ice a mile long, on account of a rise in temperature of 10 deg., is as much as 1½ft. In order to relieve the dam of the consequent thrust it is necessary to keep an open channel on the upstream side. The most effective means of maintaining this channel has been found to be the release of compressed air under water so that a row of air bubbles continually would rise to the surface along the line where the open water is desired. As these bubbles break on the surface they cause a radial flow of water, whose temperature is above freezing, to pass the edge of the adjacent ice sheet and thus check the progressive action of freezing up the open channel.

THE electrification of the Soviet Union has led to a new industry in that country—the production of hydro-electric generators. Since 1923 the Trust Electrosila has built four generators of an average of 8750 kW for the Volkhov power station and four averaging 6400 kW for the Zemo-Avchalsk hydro-electric station. At present the factory is engaged in the construction of two horizontal hydro-electric generators for the Batum station with a capacity of 3750 kW each. The Trust is also engaged in preparing designs for the construction of generators for the Dneper, Svir and Neva hydro-electric stations. Before the revolution, Russia did not produce any turbines. The production of them was begun by the Trust Electrosila in 1923. The factories of the Trust have since produced thirty-one turbo-generators with a total output capacity of over 65,000 kW, the largest unit being 5000 kW. Towards the end of this year turbo-generators of 10,000 kW will be constructed, and designs are at present being prepared for the construction of a 22,000-kW set. The Trust Electrosila intends to build a factory to produce about 100 turbines a year, and capable of manufacturing turbo-generators ranging from 10,000 kW to 40,000 kW capacity.

TWO machines for undercutting mica between commutator segments of railway motors have been introduced recently by the American General Electric Company. One is a portable outfit which can be moved to any part of the shop and clamped to the armature shaft, and the other meets the requirements of large railways for a stationary shop tool. The portable outfit has adjustable stops which limit the travel of the saw to the brush surface of the commutator and is equipped with a floating drive shaft which permits the grooving of a number of slots at one setting of the armature. It also has an angular adjustment to compensate for commutator bars not exactly parallel to the shaft. The stationary machine has a base which is provided with adjustable pillow blocks having V-shaped bearing surfaces with brass rollers for carrying the armature. Both vertical and angular adjustments are provided, the latter adjustment to be used where the commutator bars are not exactly parallel to the shaft. The circular saw is mounted on the end of the motor shaft and is supported by an offset bearing, which permits of the grooving of commutators having ears. Hand scrapers are designed to remove the fins on the mica insulation, and also burrs and sharp corners on segments which are left in the grooves by the slotting machine.

Miscellanea.

IT is proposed to construct a tunnel 29 miles long under the Cascade Mountains, Washington.

A SEAM of coal, 5ft. thick, has been discovered at a depth of 24ft. in the business district of North Sydney, Nova Scotia.

THE plant of the Stourport electricity supply system, which already amounts to 50,000 kW, is to be augmented by the addition of 30,000 kW of machinery.

IT is proposed to develop the Shusway Falls, near Vernon, British Columbia, for the purposes of supplying the town with electricity, at a cost of 1,000,000 dollars.

IT is proposed to erect an office building in Toronto, Ontario, twenty-eight storeys high, that, it is claimed, will be one of the tallest buildings in the British Empire.

A CONCRETE bridge is now under construction across Dog Creek on the Pacific Highway, about 40 miles north of Redding, California, that has a 235ft. open spandrel arch span and the roadway of which is 125ft. above the stream bed.

A STAFF of Canadian Government engineers has been instructed to make surveys of the Petitcodiac and Mamramcook rivers, which flow into the Bay of Fundy, with the object of determining the possibility of generating tidal power there.

IT is announced that the leading United States copper producers have effected an organisation, the Copper Institute, to promote closer collaboration in the copper industry, and to co-operate with the Copper and Brass Research Association and also with the American Bureau of Metal Statistics.

ALTHOUGH the old buildings at Castle Bromwich used for the British Industries Fair have already been extended by the addition of 105,000 square feet of floor space, it has been found necessary to add a further 10,000 square feet to accommodate applicants for space. The extensions occupy the space which has heretofore been bridged by the long corridor known as building A a.

To make room for the new Johannesburg railway station, it has been necessary to move the concrete grandstand on the Wanderers' ground, where the first Test Match between the M.C.C. All-English Team and the South African Team will be played at Christmas. The stand was moved bodily by rollers and winches, a distance of approximately 350 yards. It took four days to manœuvre it into position.

IN order to further the economic development of Spanish Morocco, the Government will shortly invite tenders for constructional works, the principal being a permanent steel bridge across the Wad (river) Lekkus, near El Araisch (Laraicho), the fortified port in the Azgar Province, Morocco, at the mouth of the river El Kus, 45 miles S.S.W. of Tangier. A similar bridge is to be erected over the river Moulouya. Other port works are contemplated, costing about 4,000,000 pesetas.

THE monthly report of the National Federation of Iron and Steel Manufacturers states that the number of furnaces in blast at the end of October was 162, a net increase of two since the beginning of the month, four furnaces having been put into blast and two blown out. Production of pig iron in October amounted to 596,300 tons, compared with 591,500 tons in September and 596,100 tons in August. The production includes 193,700 tons of hematite, 198,800 tons of basic, 148,300 tons of foundry and 29,400 tons of forge pig iron. The production of steel ingots and castings amounted to 699,000 tons in October, compared with 777,000 tons in September and 643,100 tons in August.

ACCORDING to a message from Lisbon, the Portuguese Government has authorised the Angola (Colonial) Administration to prepare plans and invite tenders for the improvement of the seaport of Sao Paulo de Loanda. The port, which is situated on a bay and protected by a long, narrow island of sand, is to be provided with a new wharf to enable ocean-going vessels to dock with greater facility. The present depth of water at the entrance to the bay is 20 fathoms or more; but, owing to heavy sand silts, safe anchorage can only be found about 1½ miles from shore in 7 to 14 fathoms, which necessitates vessels discharging their cargo into lighters. The proposed improvements include the construction of a mole, running for 1000 m. into the bay from Point Mae Isabel. This construction, after reaching the desired depth, will turn and run parallel with the shore. From the end of the mole the main wharf will be constructed on reinforced concrete piles for 300 m., provision being made for a future extension of 150 m. The wharf is to accommodate two steamers of 10 m. draught, and three or four smaller coasting steamers simultaneously. An electrically propelled 1500-kilo. travelling crane and a 2000-kilo. electric crane are to be acquired. The works will be executed by the Government, but all material, machinery and apparatus will be bought abroad.

BOULOGNE, already the principal fishing port of the Continent, is bracketted with Calais as the second passenger port, and is a port of call for nine Transatlantic lines linking Britain, Holland and Germany with North, South and Central America. In view of the ever-increasing passenger traffic, it has for some time been felt that improved accommodation for shipping was necessary, and with this end in view plans have been prepared by Monsieur Outrey. These have been approved by the Commission Nautique, and have been examined by Monsieur Tardieu, Minister of Public Works. The scheme provides for the construction of another breakwater running westward and then south, starting at a point in the cliffs known as La Creche, about 2 kiloms. north of the present breakwater, which is to be extended by 725 m. This would give an almost completely enclosed outer harbour of considerable size. The western portion of this, it is proposed, should be dredged to a depth of 13 m. to accommodate Transatlantic liners, and to construct new docks and quays. As Boulogne is surrounded by cliffs, this will mean reclaiming a certain amount of land from the sea. On this is to be built the quay for liners, a new dock for cross-Channel and cargo boats, and between them a long quay on which a new maritime station would be placed linked to the Nord main line by means of a tunnel known as the Ave Maria Tunnel.

MID-CHESHIRE ELECTRICITY SCHEME—SUB-STATIONS AND TRANSMISSION LINES

MR. W. FENNELL, M.I.E.E., NORTHWICH, ENGINEER

(*For description see page* 588)

FIG. 10—WEAVERHAM SUB-STATION

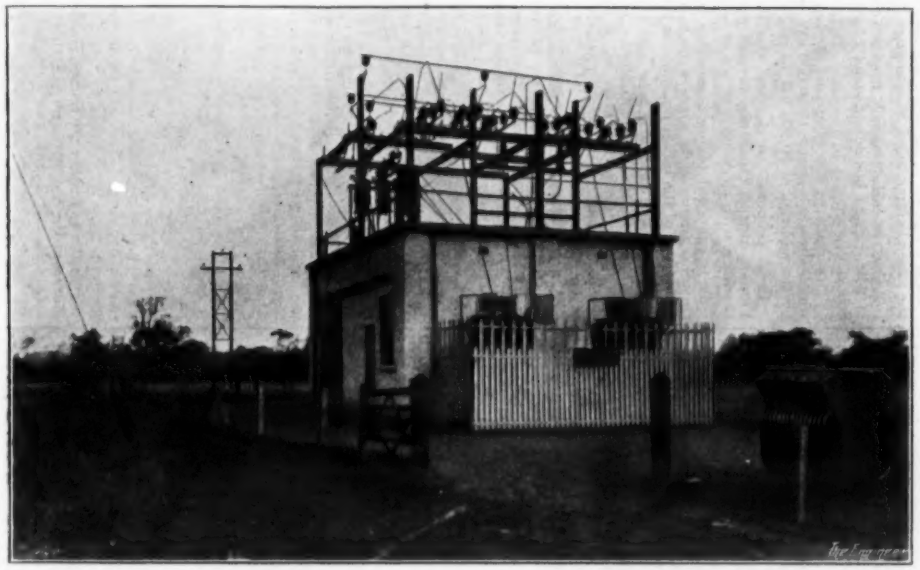

FIG. 11—WINSFORD BULK SWITCHING AND SUB-STATION

FIG. 12—33,000-VOLT TRANSMISSION LINE CROSSING RIVER WEAVER

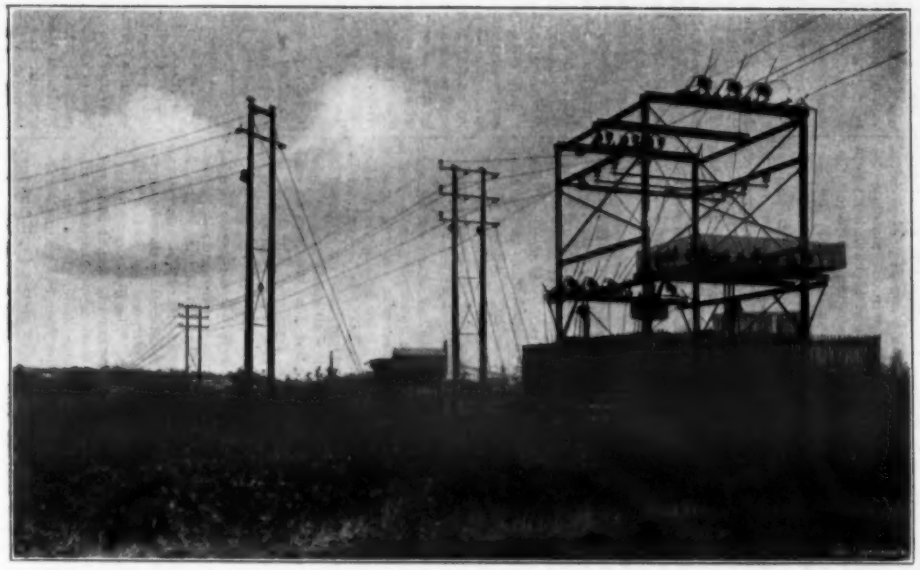

FIG. 13—WALLERCOTE SUB-STATION

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The Metallurgist

THE NOVEMBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

NOVEMBER 25, 1927.

Naval Policy and New Construction.

As announced in Parliament last week, the Government has decided that, "in the light of the situation disclosed at the recent Geneva Naval Conference," it is not necessary or desirable to lay down more than one cruiser in the present financial year. Of the other two cruisers which were to have been ordered, the "A" class ship of 10,000 tons is to be cancelled outright, while the "B" ship, of 8000 tons, may be held over for inclusion in next year's programme. The announcement is of considerable importance from more than one point of view. When the Admiralty's building programme came before Parliament in August, 1925, it was made clear that this measure provided for the absolute minimum of new construction that would be needed during the succeeding five years if the Navy were to be maintained at adequate strength. The Admiralty, we were told, viewed the existing situation with some disquietude. From 1919 to 1923, inclusive, naval shipbuilding had remained virtually at a standstill in this country, while throughout that period the dockyards of certain other Powers had been throbbing with activity. As a consequence, our Navy was slowly but surely sinking into a state of obsolescence. So far as capital ships were concerned, this process was checked by the Washington Treaty, but the Treaty did not affect lighter craft, the relative status of which had been greatly enhanced by the restriction placed upon capital ships. Our newest cruisers were those which had been laid down during the war, and some had deteriorated as the result of arduous service. All were outclassed in speed by the post-war ships of other Powers. Moreover, the adoption at Washington of a standard type of cruiser, displacing 10,000 tons and mounting 8in. guns, automatically reduced the value of our cruiser fleet, which consisted almost entirely of vessels under 6000 tons, carrying nothing heavier than 6in. guns. Clearly, therefore, the construction of new cruisers could not be further delayed save at the risk of losing control of the trade routes, upon which the life of the Empire depends. In 1924, therefore, the Labour Administration, then in office, approved the building of five 10,000-ton ships, known as the "County" class. In the following year the five-year programme was introduced. Irrespective of smaller vessels—*e.g.*, twenty-seven destroyers and twenty-four submarines—it provided for sixteen cruisers. Nine of these were to be of the "County" or "A" class; the other seven were of a modified design, displacing about 8000 tons, but also mounting 8in. guns. In the same year the Australian Government, spurred into action by the threatened abandonment of the Singapore base, ordered two 10,000-ton cruisers on its own account. It seemed, therefore, that the naval forces of the Empire would be augmented a few years hence by twenty-three ocean-going cruisers, with a uniform armament of 8in. guns.

As the essential trade routes have a total length of 80,000 miles, this provision of new tonnage could hardly be deemed excessive. It would, in fact, have been demonstrably insufficient but for two circumstances. First, our substantial reserve of older but still serviceable cruising ships; secondly, the absence of any storm clouds on the naval horizon. Although the political barometer is notoriously as unstable as its meteorological counterpart, the second factor is one that always has exerted, and always must exert, a decisive influence on naval policy. There have been times when both the actions and the words of foreign neighbours compelled us in self-defence to look to the state of our Navy. For at least half a century before the Great War we were never wholly free from a threat to our naval security from one quarter or another. First it was France, then France and Russia together, and finally Germany. Those were the days when both common prudence and political sagacity constrained us to match keel for keel, and to provide an ample margin to boot. More than one effort was made to end this provocative and expensive shipbuilding rivalry by international agreement, but to no purpose. The abortive Hague Conferences and the equally vain attempts to come to a naval understanding with Germany convinced our people that Nelson's aphorism still held good: "There is no better negotiator in the councils of Europe than a fleet of English battleships." But in recent years a marked change has taken place in the political interrelationship of the Great Powers. This change is due in part to associations which have survived the war, and in part to the growing influence of the economic element. Twenty years ago the mere suggestion that Great Britain should accept naval equality with any other country in the world would have been repudiated with derision by nearly all Britons, without distinction of party. Yet what seemed unthinkable then is now, in principle at least, an accomplished fact, and no one in this country sleeps less soundly at nights because of that fact. A fixed ratio of battleship tonnage as between ourselves, the United States, Japan, France, and Italy, was agreed to six years since. Is it, then, any wonder that thoughtful men in each of those countries should continue to urge the extension of this restrictive system to armaments in general? It is true that the hopes inspired by the success of the Washington Conference were momentarily dashed at Geneva last summer. It is no less true that later events seem to be vindicating the judgment of those who declined to take a tragic view of the Geneva affair. The era of unbridled naval competition which then seemed to be imminent has not yet dawned. Since the Conference adjourned not one of the three Powers represented has authorised a single new keel. On the contrary, Great Britain has dropped two important ships from her current programme, because of "the situation disclosed at the recent Conference." Baron Saito, the Japanese statesman who represented his country so ably at Geneva, continues to advocate a fresh effort to reach agreement; and with rare exceptions the most influential organs of the American Press are preaching moderation in respect of new naval construction. In some quarters at home the Government's action has aroused strong criticism. We are not sure, however, that the critics apprehend the situation. The British Government and people earnestly desire to avoid any semblance of naval rivalry with the United States. The American Government, judging from recent utterances by its spokesmen, is equally disinclined to set the pace in naval armament. Nevertheless, being committed to the principle of equality in naval power, it is apparently resolved to attain such equality, preferably by agreement, but if that be impossible, then by actual building. As we have already acknowledged America's claim to a co-equal measure of strength

at sea, it is obviously wise policy on our part to leave the door open for further negotiation on this subject. By dropping two cruisers from this year's building scheme we have offered America convincing proof of our sincerity. We are very sure that the gesture will evoke a generous response.

It cannot be said that the omission of these two ships—only one of which is definitely cancelled—exposes us to serious risk. When announcing the decision, the First Lord of the Admiralty was careful to state that it was not "necessary" to lay down more than one cruiser this year. The fact is that current foreign programmes are, without exception, considerably behind time. Of the eight American cruisers that were authorised in 1924, only five had been laid down up to last month, and orders for the remaining three have been placed only recently. The four Japanese 10,000-ton ships are making slow progress, and are not likely to be completed before 1929 at the earliest. The corresponding French ships are at least twelve months in arrear, and no credits have been voted as yet for the present year's quota of new tonnage. In these circumstances, the deletion of one cruiser and the postponement of another is not calculated to prejudice national security, and if, as is possible, it should prove to be the first step towards a comprehensive agreement with America and Japan on the naval issue, the sacrifice will have been more than worth while. On the other hand, the loss to industry is severe enough. The "A" class cruiser, which was to have been built by contract, was priced at about £2,000,000, two-thirds of which would have gone in wages. The shipbuilding and allied industries of Great Britain have, indeed, been the chief sufferers from naval disarmament, a fact of which the world has just been reminded by the circumstances that led up to the Vickers-Armstrong amalgamation.

Troubles with High Pressure Steam.

THE Institute of Fuel was fortunate enough to secure for its first technical meetings, which took place this week, several papers of outstanding importance. Amongst them is one entitled "Operating Experiences with 1300 lb. Steam Pressures," in which Mr. John Anderson, vice-president, Milwaukee Electric Railway and Light Company, discusses in admirable detail the troubles which have been experienced with the 1300 lb. steam plant at the Lakeside station, Milwaukee. It is, to the disadvantage of all concerned, the common practice to hush up unfortunate experiences, either from a mistaken idea that the publication of them may arrest progress, or from the still worse idea that it is bad business to share your experiences with others. Mr. Anderson is inspired by a motive more worthy of respect. "The object of this account," he says, "is to tell of these troubles in detail for the advantage of the future of power industry." He feels, rigatly, that what is good for one is good for all, and that the "power industry" will gain more by an open disclosure of the facts than it would if he jealously retained to himself the knowledge he had acquired, on the ground that it was not his affair to teach others their business. We commend his paper, of which we give an abstract on other pages, to our readers, not alone for its very valuable contents, but for the spirit in which it was written.

The Lakeside high-pressure plant operates in the same manner as that at Edgar station, and like that which Mr. Roles is installing at Bradford. Steam at a very high pressure, 1300 lb. in this case, is used in a small turbine. It is exhausted at 300 lb. or so, reheated, and returned to the 300 lb. mains which supply larger turbines. The improvement in *station* efficiency which is secured by this means is in the neighbourhood of 4 per cent. The efficiency of the high-pressure plant alone is, of course, higher, and all such experiments must be regarded as but a step towards the adoption of super-pressures for a greater proportion of the total installed capacity. By making such experiments on a relatively small scale, it is possible to learn something, in advance, of the difficulties which they entail, without interfering seriously with the output of the station. We will not say that the troubles at Lakeside of which Mr. Anderson gives us such a valuable account were wholly unforeseen by engineers, but we will say, and those who desire to do so may readily confirm the statement by reading the paper, that the difficulties most feared have not been encountered, and that those which have occurred were less often canvassed before the plant was laid down. The problems which excited most attention, both in Europe and America, were connected with the use of materials under high pressures and temperatures. Of such problems Mr. Anderson speaks hardly at all, save as they affect boiler tubes in particular circumstances, and we may assume therefore that, if they have existed, they have been of small moment. It is with a quite different class of problem that he deals. The difficulties he has met and overcome may be defined in outline in a few words. In the first place stand failures caused by deposits of scale on the tubes. A "sixpenny scale," so sought after by marine engineers fifty years ago, was tolerable; it did not interfere materially with the high rate of heat flow. But it could not be maintained. The scale thickened, the tubes blistered, and finally punctured. It is of particular interest to note that it was the fin tubes of the furnace walls that failed from this cause. A thickness of one-thirty-second of an inch was not injurious, but when the scale reached one-sixteenth of an inch it was found that a tube temperature of about 900 deg. Fah. was reached, and at that temperature the metal gave way under the pressure. The history of the search for the scale-forming material and its final discovery in a leaky condenser is well told by Mr. Anderson. The second cause of trouble occurred in the boiler tubes proper, as well as in the fin tubes. It was corrosion. It arose after the adulteration of the feed with scale-forming water had been arrested, and was very severe. "In some cases deposits (of black oxide) of such magnitude were built up in the tubes during this short time (130 hours) that it was impossible to see through a short length of tubing." De-aeration of the water was indicated, but treatment with alkalies—tri-sodium phosphate—was also adopted. These steps reduced the corrosion, and incidentally the incrustation, but they resulted in yet another kind of trouble. The capacity of the 1200 lb. turbine began to fall off. In less than a day and a half the output dropped from 6600 kW to no more than 4200 kW. Here was a new and unexpected difficulty. The turbine was opened and about half the blading—the later stages—was seen to be covered with a white soluble deposit. The source of this material could not be in doubt; it was steam-borne from the boiler compound. An inquiry into the amount of moisture in the steam was the next step. It was found to reach sometimes one-third of one per cent., and was corrected by fixing baffles in the top drum and by reducing the concentration of solids in the boiler. Thus this train of investigations was brought to an end, and the safe and continuous operation of the plant was ensured.

No engineer who reads even this very brief summary of the experiences at Lakeside can fail to be deeply interested. Nor will he fail to notice how all the difficulties hang together. First, the scale; then the corrosion which occurred when the deposition of scale was arrested; and, finally, the deposit on the turbine blading which resulted from the steps taken to prevent corrosion. We congratulate Mr. Anderson on the courage and pertinacity with which his inquiry was pursued, and the success which he has attained. His conclusion is that "though higher pressure puts more exacting requirements upon boiler materials, safe and continuous operation is positively possible. Desirable reaction to feed treatment is proved, and no conditions have occurred which were not corrected satisfactorily. There is every reason to believe at present that the unit can be kept in service as long as desired, and an order for an additional 1300 lb. equipment will soon be placed." He has therefore by this inquiry laid at rest some of the fears aroused by the use of super-pressure, and has forewarned those who may follow him of difficulties that may be encountered. We may say that the condenser ought not to have leaked; that untreated make-up water should not have been used; that moisture should not have been allowed to enter the turbine. But we may still doubt if many engineers, accustomed to lower pressures, would have foreseen the train of accidents which followed from the commission of acts which would have been without evil effects in other circumstances.

Obituary.

HENRY EDMUNDS.

WE regret to have to put on record the death of Mr. Henry Edmunds, which took place on Friday last at Hove.

Henry Edmunds, whose father bore the same name, was born in Halifax in 1853, and was therefore seventy-four years of age at the time of his death. Possibly to many engineers of the present generation his name, even, may be unknown, but when at the height of his activities there were few men more conspicuous in many directions or better known in Westminster than he was. He appeared to be never so happy as when investigating something new. With many of the inventions which were made during his active professional life he was connected in one way or the other, and generally in the initial stages of their development, in some of which he played a leading part.

A visit to the United States in 1877, when he was only twenty-four years of age, had some far-reaching results. For one thing, he made the acquaintance of Edison, of whom he eventually became a personal friend. That, in due course, led to his bringing to this country the first phonograph. Then, too, he is credited with having introduced the arc-lighting machines of Brush into this country, and was the first engineer of the Anglo-American Brush Electric Light Corporation—now the Brush Electrical Engineering Company, Ltd. The Brush arc-lighting machine, it will be remembered, has an armature reaction of such a character that the current remains practically constant, no matter what the load, and it had a considerable vogue for series arc lighting over a lengthy period. Mr. Edmunds also, as a result of his visit to the States, brought back to this country the Farmer-Wallace system of electric lighting.

In America, too, he must have come across Graham Bell; at any rate, he was familiar with the latter's telephone as early as 1878, for we find him embodying it in an invention for transmitting sounds between places separated by water without the aid of insulated cables or wires, and thereby conveying signals to ships and boats from the shore or to and from each other, "under circumstances when other kinds of communication are inconvenient or impracticable." To this invention he gave the name of the "hydrophone," and in it he proposed to effect communication between ship and shore and ship and ship by setting up vibrations under water and providing the vessels with some means of intercepting those vibrations. In its simplest form the apparatus that he used consisted of an ordinary trembling bell enclosed in a water-tight box at the transmitting end and an oar or boat hook held with one end in the water by a man in a boat, while the other end was applied to his ear, a predetermined code of signals being, of course, employed. In more elaborate applications a telephone in connection with a recording apparatus—similar to that used in Morse signal telegraphy—was employed at the receiving end. A further development was to equip, say, the flagship of a fleet with a transmitting apparatus tuned to certain vibrations and to fit all accompanying vessels with receivers tuned to respond only to those vibrations. Still another application was to arrange transmitters on sunken reefs, so that warnings might be given to approaching vessels.

The year 1878 was, in fact, a busy period for Mr. Edmunds, for not only did he invent and exhibit at the Royal Institution a phonoscope, but he also invented and patented a process for recovering the tin from tin scrap by means of heat and centrifugal action, as well as improvements in arc lamps, and, furthermore, he electrically lighted Liverpool-street Station—the first railway terminus in this country to be so treated, though Charing Cross was not much later.

Then, again, when Mr.—afterwards Sir Joseph—Swan invented his incandescent filament lamp, he very early became associated with him, and took Swan lamps to Paris for the Exhibition of 1881, where they were employed in illuminating the Opera House. In the same year he fitted H.M.S. Inflexible for electric lighting, as well as the liner City of Richmond, and other Atlantic steamships, including the Servia.

In 1885 Mr. Edmunds became a partner in the cable-making firm of W. T. Glover and Co., and was first chairman of W. T. Glover and Co., Ltd. He was also instrumental in founding the Cable Makers' Association.

Then, again, he was among the first to interest himself in motor cars when they were first introduced, and throughout his life he kept in close touch with the development of motor vehicles. As early as 1898 he imported from Paris a De Dion motor cycle and trailer, which attracted a good deal of attention. It is said, too, that it was he who introduced the late Hon. C. S. Rolls to Mr. Royce, and was thus instrumental to some extent in the formation of the famous Rolls-Royce firm.

Mr. Edmunds became an associate of the Institution of Electrical Engineers—then the Society of Telegraph Engineers—as long ago as 1879, and was made full member in 1881. At one time he served on the Council of that body. He was elected a member of the Institution of Civil Engineers in 1899. He was also first President of the North of England Electrical Engineers. In addition to his other activities, he was chairman of the General Cement Company, and was Master of the Glaziers' Company in 1912.

THE Great Western special from Plymouth to Paddington on November 15th, with passengers off the Mauretania, saved 19 minutes of the booked time of 4 hours 10 minutes. The average speed was therefore 59 miles per hour. The engine was the Builth Castle and the load 279 tons.

Engineering Materials Conference and Exhibition at Berlin.

THE co-operative spirit which reigns in German industry and the realisation by manufacturers that with high wages and shorter hours of labour their products must compete in the markets of the world rather by intrinsic quality than by lowness of price, were both strikingly exemplified in the Conference on and Exhibition of Engineering Materials which has just closed in Berlin. The Congress was organised by the Verein deutscher Ingenieure, a body which has no counterpart in numbers, power or activity among our own technical institutions, in conjunction with the great industrial associations, such as the Verein deutscher Eisenhüttenleute, the Deutschen Gesellschaft für Metalkunde, and the Zentralverband der deutschen Electro-technischen Industrie, which are concerned with the interests of German manufacturers. The field of the Congress was limited to subjects pertaining to metals, both ferrous and non-ferrous, and to electrical insulating materials, but the working and testing of metals formed quite the predominant features. The Conference meetings were held from October 24th to November 4th in the Technical High School at Charlottenburg, and when we mention that during these eleven working days no less than forty-one meetings were held for the consideration of 224 separate papers, each of twenty-five minutes' duration, divided into thirty-nine groups of subjects, the impossibility of dealing adequately with this aspect of the Congress will be understood. One is tempted to think that if nine-tenths of the authors of papers had contributed their special knowledge in the form of discussion on papers presented by the other tenth, the proceedings might have been more interesting, if not more informative—but this is not our business; every nation has its own way of doing things. It is on record that about 5000 engineers attended these meetings.

From the first conception of the Congress, it was the intention that the Conference on Engineering Materials should be supplemented by a comprehensive and instructively arranged exhibition of such materials. The manufacturers supported this idea, not with the primary object of displaying or selling their products, but in a manner which illustrated in the most convincing manner possible the co-operative spirit to which we have alluded above. No stand bore the name of any firm, no advertisement of any kind was exhibited or leaflet thrust into the hand of the visitor. The whole of the articles were strictly anonymous, except in the case of a possible name plate on a machine, and the exhibits were grouped according to nature or purpose without the least reference to the firms that may have supplied them. The display was as neutral as that of a museum. If one wanted to know where a given article could be obtained he had to ask. If he merely wanted to have technical information concerning it, or in the case of a machine to see it in operation, his desire was satisfied by a fully qualified attendant who confined himself to technical matters.

It is evident that such an Exhibition, organised to represent particular branches of German industry as a whole, rather than to advertise individual manufacturers, permitted an arrangement of articles far more systematic and convenient for the visitor than would otherwise have been possible. The Show, which was open from October 22nd to November 13th, was housed in the New Automobile Exhibition Hall, on the Kaiserdamm, a building about 550ft. long by 250ft. wide, with the arched roof and side galleries typical of such buildings. Exhibits were also arranged outside the building. They varied from a rolling mill to a one-piece copper vat for brewing purposes, which had a diameter of about 16½ft., with a depth of 5½ft., and weighed close upon 3¼ tons. There was also a steel house with steel furniture, and over the main entrance to the Exhibition building a 100ft. girder, rolled from a single billet, was displayed. One side of the interior of the building was devoted to ferrous metals and the other to non-ferrous metals, while the central floor was mostly occupied with testing machines and scientific apparatus of all kinds appropriate to metallurgical affairs. Over 200 different kinds of testing machines were shown in operation, and the testing floor was served by an electric crane. Some idea of the scale upon which things were done may be gained when we say that a 1500-kW generator set was needed to supply current and upwards of 7000 cubic feet of gas were used per hour. There was also on the central floor a railed-off section, about 80ft. by 140ft., where most spectacular demonstrations of high voltage testing were given twice a day. Each demonstration consisted of a lecture lasting an hour, made audible in the adjacent galleries by excellent loud speakers, and punctuated by experiments showing the flashing over of insulators and spark gaps under an application of voltages up to 1,000,000. Voltages of this magnitude with high-frequency, normal-frequency, and direct current were employed and the difference of the effects illustrated. At the evening "performance" the lights at that end of the hall were put out, to make the display more impressive still. The insulators under test were suspended from the roof, so that the effect of these enormous voltages was apparent to the several thousand people who collected in the neighbourhood when the demonstrations were in progress. A further popular feature of the Exhibition was the kinematograph display of films representing metallurgical processes. The manufacture of steel from the ore to the finished metal by the Bessemer and Siemens processes were among the subjects. Some of the views were really wonderful examples of photographic technique; in particular, we may mention pictures of the interior of a Siemens furnace showing the charge melting from the time the metal first commenced to drip until its complete collapse and fusion by the "fervent heat."

FIG. 1—EXHIBITION HALL WITH ELECTRICAL TESTING PLANT IN BACKGROUND

The general appearance of the Exhibition will be gathered from Figs. 1 and 2. In the first of these views, the one-million volt testing plant can be seen in the background, while the second gives a more complete idea of the arrangement. Fig. 3 shows one of the stands arranged to demonstrate the various tests applicable to a connecting-rod, stub axle and steering gear lever of a petrol lorry. Every test which would be carried out and the parts from which the respective test pieces are cut are shown by the reconstructed objects. The German iron and steel organisations were particularly anxious that the testing of materials, as being the decisive criterion of their quality, should be the essential feature of the Exhibition. Hence, although there were to be seen such products as a large three-throw crank shaft forged solid, for a marine Diesel engine, a lap-welded drum with walls about 2·5in. thick, a length of dredger chain with buckets, locomotive driving wheels, and so on, things of this kind were given little prominence. On the other hand, there were to be seen, as we have already mentioned, some 200 different machines for making every kind of test that a user or maker of metal could desire. One of these, for testing the power absorbed by bearings, is illustrated in Fig. 4. The bearing to be tested is placed on a shaft carried by the two standards at the right of the machine, and the load on it can be adjusted by the hand wheel beneath. The shaft is driven from the far end by the motor underneath, and contains a thin flexible length, surrounded by a rigid sleeve. On the latter is mounted a hollow disc with a circular window through it near its rim. Through this window can be seen the rim of another disc fastened to the flexible shaft, so that the torque of the latter can be observed. When the machine is in action, the discs, of course, are rotating rapidly, so that provision has to be made for rendering the torque visible. This is done by having a lamp at the side of the hollow disc. The light passes through the hole to an inclined mirror on another disc running at equal speed, and is there reflected up an eye tube—not shown in the photograph. Persistence of vision renders the torque easily readable. One of the important features of the machine is the way in which the friction of the main bearings is eliminated, for without special provision this would, of course, be additional in its effect,

FIG. 2—GENERAL VIEW OF 1,000,000-VOLT ELECTRICAL TESTING PLANT

to the friction which it is the object of the machine to measure. Each of the main bearings is not only a ball bearing itself, but runs in another ball bearing, the latter being positively driven at the same speed as the shaft. Hence, there is no relative motion at all between the shaft and its own bearings, and hence no friction. Another noteworthy machine was a fatigue testing machine designed to give four million changes of load in each twenty-four hours.

A part of the Exhibition which attracted many visitors was that devoted to the lighter metals and their alloys. A noteworthy exhibit in the section for pure aluminium was a plate 33ft. in length with a breadth of nearly 10ft. and a thickness of 7 mm., or a little over ¼in. The manufacture of aluminium was illustrated by wall diagrams, and the various intermediate stages in the making of aluminium foil were also to be seen. Another interesting section was that in which heat-treated aluminium alloys were exhibited, the range of metals including the well-known alloy duralumin, with perhaps the lesser known Aludur, Lautal, Skleron, Aeron, Constructal, Montegal, Aldrey, and Telectal. The various uses of these alloys were illustrated by diagrams, while to show the employment of Duralumin in aircraft construction a complete all-metal Junkers aeroplane was on view, along with a Rohrbach machine and parts of a Zeppelin airship body. There was also displayed a series of models illustrating new developments in aircraft construction and novelties included a Reed propeller made of Aeron and thin-rolled plates of Silumin, an alloy which until recently has only been used for castings. Two items of mining interest call for mention. They were mine cages and colliery tubs made of Duralumin, which metal, compared with iron construction, showed a saving in weight of nearly one-half. There were also many examples of the use of Duralumin and Constructal for such diverse purposes as motor car wheels and bodywork, gongs, vessels for agricultural use, and the tall rotating cylinders for Flettner rotor ships. The use of the lighter metal alloys for electrical conductors for overhead transmission lines was indicated by examples of special alloys made for this purpose, such as Montegal, Aldrey and Telectal. Among the cast specimens in the aluminium section were samples of the American alloy 92 per cent. Al, 8 per cent. Cu, and the German Silumin alloy, 88 per cent. Al, 2 per cent. Cu, and 10 per cent. Zn, while other specimens included the new non-corrosive metal "KS-Seewasser" and the alloys Alneon and Neonalium, which are characterised by very high elastic values with a permanent set of only 0·001 per cent.

In the transport industry magnesium and its various alloys is becoming increasingly important, which fact was evident from the interest displayed in this metal. Under the name of Elektron alloy was shown a wide range of both cast and built-up articles. These were mainly parts for aircraft engine and body construction, among which we noted some landing wheels. Another example consisted of a petrol fuel tank, with a designed capacity of close upon 100 gallons, which only weighed about 12¾ lb.

Of the high educational value of the Exhibition there can be no manner of doubt. Visitors, of whom about 13,000 entered per day in spite of an ordinary admission charge of 1s. 6d., saw not only well-known metals in all forms, from ingots of steel to gold and silver, aluminium in films thin enough to be transparent as tinted glass, but all the innumerable alloys which the metallurgists have devised to give hardness, resistance to corrosion, lightness, brilliance or other desirable quality. A very wide range of electrical insulating materials of every kind was also on view. Visitors could see every form of test carried out, and measurements made of hardness, cutting quality, brittleness, &c. The examination of metals, by chemical analysis, and by X-rays for internal flaws was demonstrated to everyone who cared to see it. Constitution diagrams of alloys, macro and photo-micrographs, stereo-models of molecules, X-ray photographs to show atomic arrangements and other educational objects confronted the visitor at every turn. One kind of placard deserves the highest commendation, and might well be introduced into every technical school in England. A typical example comprised about eight or ten small illustrations. These were arranged in pairs, in parallel columns, the first column headed "Wrong" and the second "Right." Each pair demonstrated how to do, and how not to do a certain thing. One pair, for example, illustrated a section of a part of a flanged bed-plate with facings for bolts or other fittings. The "wrong" sketch showed the use of an internal, as well as an external flange, which, of course, would necessitate core-boxes, and a facing isolated from the flange in such a way that it could only be moulded with a loose print on the pattern. The "right" sketch, of course, showed a bed-plate as it should be made, one that would leave its own cores, and draw out of the sand without any loose bits to bother the moulder, or to be forgotten or misplaced. Other examples referred to forged steel levers and showed how the bosses ought to be designed to facilitate the work of the smith or to make die stamping easier. The great fault of young men coming to practical work after an ordinary technical school education is that they have no knowledge whatever of matters of this kind, and no appreciation of their real importance. Indeed, we have actually seen such horrible things as drawings of flange couplings secured by gib-headed keys driven in from the boss side of the couplings, put before students as examples of engineering practice, and with such teaching it is not to be wondered at that technical education is not appreciated as it should be by practical men. The German method of instilling correct ideas is probably the next best thing to learning them in the shops by an early apprenticeship, and the educational value of a few illustrations of the kind we have mentioned may well be greater to a young engineer than whole books of mathematical theory.

For those who were not able to visit the Exhibition, but who, nevertheless, would like to make themselves familiar with the composition of the different metals shown, the manner of treating them, and their characteristics and uses, it may be stated that two special hand-books have been prepared and published, giving these particulars in a permanent form. One of the books deals with iron and steel and the other with the non-ferrous metals. A loose-leaf type of book has wisely been chosen, so that alterations can be made and new matter added to the specialised particulars already given. Each book has from 300 to 400 pages, and is published at a price of 24 marks. Other literature which was also available at the Exhibition included the reports of the Standards Committee—Normenausschusses des deutschen Verbandes für die Materialprüfungen der Technik (V.D.M.), and of the Technical School Committee—Deutschen Ausschusses für Technisches Schulwesen (D.A.T.S.C.H.), under the auspices of which some of the placards and teaching material to which reference has already been made were drawn up. It is also intended, we understand, to publish the various papers given at the Congress, together with the discussions, in a collected form. Further particulars concerning the books mentioned in this article can be obtained from the V.D.I. publishing department, Ingenieurhaus, Berlin, N.W. 7.

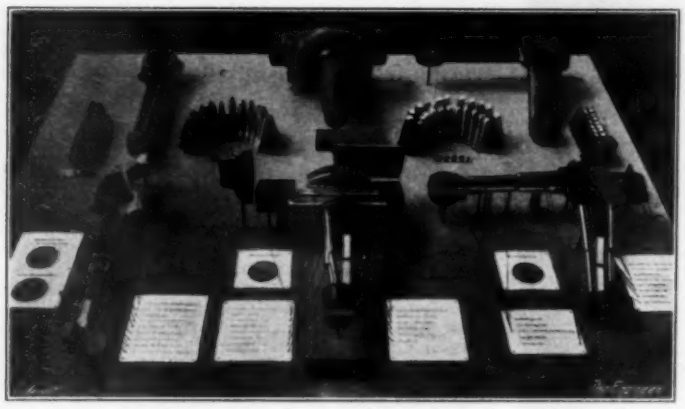


FIG. 3—METHODS OF TESTING AUTOMOBILE FORGINGS

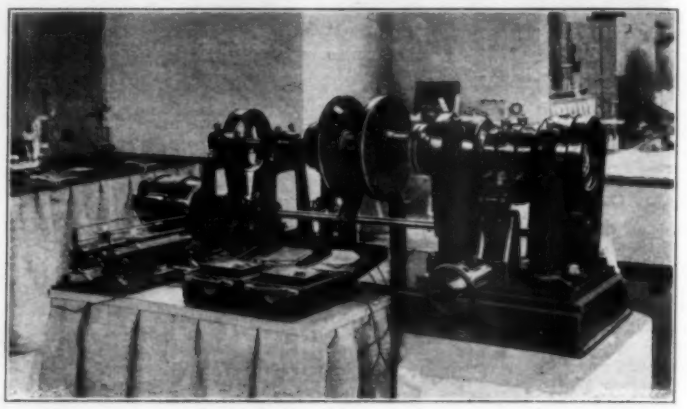


FIG. 4—TORSION DYNAMOMETER FOR TESTING BEARING FRICTION

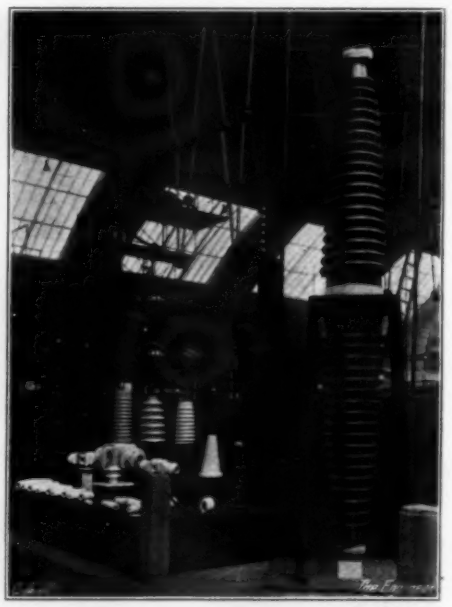


FIG. 5—500,000-VOLT AND OTHER INSULATORS

Institution of Mechanical Engineers.

On Friday evening of last week, before a well-attended meeting of the Institution of Mechanical Engineers, Mr. Hal Gutteridge presented an interesting and instructive paper on modern Portland cement plant. We begin to print an abstract of this paper elsewhere in to-day's issue. Mr. Gutteridge illustrated his paper by means of a cinematograph film, as well as by numerous lantern slides, showing the processes and machinery employed in the production of Portland cement.

Mr. G. V. Maxted opened the discussion by recalling the conditions of the Portland cement industry when he first became interested in it in 1880. Rule-of-thumb and haphazard working prevailed, he said, in those days. The chalk and clay were mixed and judged by their "feel," and laboratories, if they existed, were staffed by old men and boys. Tests of the strength of the cement produced were crude. No tensile testing machines existed. To determine the tensile strength of the finished cement a brick would be plastered against a wall and next day another would be added to it, and so on until the bending moment became too much for the cantilever, and the bricks broke off. The cement would then be said to be "so many bricks strong." The kilns used were of the dome type, a form which by reason of its extravagant fuel consumption was a boon to the coal industry. It was thought to be a great advance when chamber kilns combining the drying of the slurry and the burning of the clinker were introduced about 1880. The rotary kiln had been developed since about 1900, and had practically revolutionised the industry. Grinding had also been greatly improved, as, for example, by the introduction of the tube mill. Commenting upon modern practice, he remarked that in this country most of the cement was produced by the wet process. The slurry contained from 36 to 45 per cent. of water. It might be blown into the kiln through a jet feed, a method of working which was a distinct improvement upon the older one of delivering the slurry to the kiln in the form of a stream. In America it was common practice to de-water the slurry as a preliminary process. The filters employed were so efficient that the working of the kilns might almost be said to be on a dry basis. The temperature of the outgoing gases was, as a consequence of the removal of the bulk of the water, such as to render the use of waste heat boilers practicable and profitable. So much so was this the case that in the United States it had been found possible to obtain from the kiln gases all the power required in the factory. With the wet process, the temperature of the outlet gases was about 750 deg., and was useless from the point of view of waste heat boilers. In this country he felt certain that power costs could be greatly reduced by the adoption of waste heat recovery. An additional saving could be made by lagging the kiln, but he thought that it would be

practicable to do so only from the driving ring, at the middle of the length, onwards to the inlet end. There were many points in favour of making the cooler a prolongation of the kiln, such as a reduction in the height of the building required to house the kiln and in the height of the piers supporting the kiln. In this country it might prove profitable to adopt the plan of insulating the kiln between the fire-brick lining and the steel shell. Dealing with the method of driving the kiln, he commented favourably on the new central drive system.

Mr. Percy J. Neate, the inventor of the "sun and planet" slurry mixer, dealt with a number of minor points raised in the paper. He criticised, for example, the author's remarks regarding the proving of the raw materials by means of bore-holes. The information obtained from bore-holes might, he said, be very misleading, unless the work were most carefully watched at all stages. It was better, he maintained, to dig right through the detritus before sinking the holes. On the subject of gas and oil fuels, as opposed to pulverised coal for firing the kilns, he remarked that the ash left behind in the clinker when coal was used was quite a good cement-making material. In any event, why should the cement manufacturer grumble when custom permitted him to sell coal ash at the price of Portland cement? Dealing with the use of booster pumps for the pumping of slurry, he stated that he had pumped thin slurry a distance of 4½ miles without the use of boosters. The ability to pump slurry depended upon the viscosity of the liquid, but the viscosity did not depend upon the specific gravity. That fact was of importance when the size of the conveying pipes was being fixed. Discussing the action of the sun and planet mixer, he said that the slow rotation of the main lattice girder carrying the power-driven stirring arms was produced by the reaction between the slurry and the walls of the tank. In his earliest design he had arranged to drive the main girder through differential gearing, but was greatly surprised to find that when the mixer was set to work the main girder started to rotate in the direction opposite to that in which it should have rotated. Continuing, he stated that it was not really necessary to use a weighbridge for measuring the raw materials as they came from the quarry. With experience, chalk and clay could be tipped into a wash mill with sufficient accuracy to meet a very close analysis entirely without the use of weighing apparatus. The same result might be obtained by running the raw material into silos, by analysing the contents, and by mixing the under-limed and the over-limed batches. Discussing the method of measuring the quantity of slurry in a tank, he said that nothing could surpass for convenience and accuracy the use of a simple foot rule. On the subject of kilns, he agreed that curved lifting plates attached to the inside walls produced a definite economy in the coal consumption. The distortion to which they were subjected was, however, a very serious drawback to their use, and the kiln had frequently to be stopped over long periods for replacements. For that reason the plates gave more trouble than they were worth. The economy in coal consumption which they showed was more than counterbalanced by the losses which they caused in other directions.

Mr. Thomas Rigby dealt with the advantages attending the adoption of the atomising method of feeding the slurry into the kiln. Summarising the benefits claimed for short kilns with the atomising feed, as compared with long kilns having ordinary methods of feeding, he said that with the former the fuel consumption per ton of cement produced was lower than with any other method. The clinker was more uniform in size and better burned. The kiln was cheaper to build, and for a given weight of kiln the output was greater. Less power per ton of cement was required, and the cost of grinding the clinker was reduced by virtue of the small-sized clinker characteristic of the atomising process. Finally, the buildings for housing the kilns were much cheaper to erect.

Mr. W. H. Woodcock dealt with the chemical aspect of Portland cement production and claimed that within recent years there had been at least as much progress made on the chemical side as on the mechanical side. In former times, he stated, high lime content in the mixture made complete burning difficult, but with the introduction of improved kilns higher temperatures were practicable, and as a consequence increased lime content could be used. The increase had been from about 58 per cent. to 63–64 per cent. of lime. The high lime content improved the quality of the cement and, together with improvements in the fine grinding of the clinker, led to the cement developing a high strength in a short time. With a given lime content the results obtained from the cement were the same whether the material was burned at a high temperature for a short time or allowed to soak at a lower temperature for a prolonged period. At the high temperatures the point of failure of the kiln lining was approached very closely, and it was largely a question of economics to determine which practice to follow. In the latest type of kiln a fuel consumption of 24 to 25 per cent. was guaranteed with slurry containing 40 per cent. of water.

Mr. Henry Pooley said that the author had mentioned two methods, the mechanical and the pneumatic, for preventing the slurry from settling in the tanks. There was, however, a third—devised by the Door Engineering Company of America—in which the mechanical and the pneumatic methods were combined. In the Door system ploughs attached to rotating arms carried the slurry inwards from the bottom of the tank towards the centre, where air lifters raised it and re-distributed it over the surface. For a tank 34ft. in diameter by 21ft. deep 6 H.P. was required under the Door system, together with 50 cubic feet of free air per minute at a pressure of 25 lb. by gauge.

Mr. Wm. Reavell asked the author to tell him what was the advantage of using an air lift in cement works in preference to a pump. The efficiency, he thought, could not be so good, but it might be that the upkeep of pumping plant was found to be expensive by reason of the grinding effect of the slurry on the pump parts.

Mr. C. C. H. Brazier criticised the author's statement that as a rough rule the power required to grind cement clinker is directly proportional to the fineness of the resultant product. Mr. Brazier stated that the law did not follow a straight line by any means. The horse-power required per ton of material ground went up very considerably with the degree of fineness.

Mr. Thomas Clarkson recalled facts which led him to believe that Mr. Maxted was wrong in stating that no means existed in 1880 of testing the tenacity of cement mechanically. He added that in Germany, thirty-five years ago, he had seen ball mills in use and also, he believed, rotary kilns.

Mr. T. Walley asked the author if he had any knowledge of the use of rubber lining in cement grinding plants. He stated that the lining consisted of a layer of vulcanised rubber about $\frac{1}{8}$ in. thick next the steel shell, over which two or three layers of canvas were spread, followed by a thick layer of soft rubber with a waved contour. Such linings, he said, were now reported to be replacing steel linings and were claimed to save from 10 to 15 per cent. of the power required to deal with a given quantity of material.

Mr. F. E. Schmidt exhibited a graph showing the variation with temperature in the specific heat of Portland cement, and stated that if the figures of the curve were applied to the heat balance data given by the author considerably different results would be obtained.

By reason of the lateness of the hour Mr. Gutteridge was prevented from replying to the discussion.

Operating Experiences with 1300 lb. Steam Pressure.*

By JOHN ANDERSON, of Milwaukee, U.S.A.

Though the high-pressure installation at the Lakeside Station has been in service 57 per cent. of the eleven months' period since starting, operating one continuous period at full capacity—approximately 300 per cent. boiler rating—for fifty days, and improving overall plant efficiency 4 per cent., major troubles have been experienced. The object of this account is to tell of these troubles in detail for the advantage of the future power industry.

The desirability of 1300 lb. steam pressure is certain, and widespread adoption will occur in the very near future. It is felt important that detailed information on operating experiences be widely disseminated, for the power industry is so large and is growing so very rapidly that the interchange of information nets great economic savings.

Outline of Experiences.

This account is divided into three parts, discussing:—

(1) Experiences with tube failures from scale formation.

2) Boiler tube corrosion troubles.

(3) Chemical control of feed water and resulting correction of trouble.

Though only eleven boiler and fourteen turbine stoppages have occurred in the eleven months of operation, several of which were necessary for inspection, some have been too long, others were for rather expensive tube replacements, and one stoppage of forty-two days was necessary for an air heater change.

Scale Trouble Period.

The first suggestion of tube trouble occurred after 880 hours' operation, when a hissing noise was heard in the furnace, suggesting a small steam or water leakage. An inspection showed that a front wall fin tube near the east wall had bulged near its upper extremity, presumably where highest heat transfer occurred due to nearness to the burner tips.

Cutting of the tube into cross sections showed that it was coated quite uniformly with $\frac{1}{32}$in. of scale over the side exposed to the furnace except at the bulge, where scale filled nearly the entire extruded section. Whether the $\frac{1}{32}$in. scale caused the bulge or whether greater thickness had collected previous to the failure could not be deduced. The bulge, like all others later experienced, was about 1½in. in diameter and ¼in. high. Probably fifty similar bulges were observed during later experience with scale trouble, and though some were almost adjacent over lengths of several feet on a single tube, no splitting of the tube with consequent explosive rupture occurred. Operation over two weeks with this kind of leakage has proved that high-pressure operation is entirely safe.

A very small hole at the tip of the bulge of less than $\frac{1}{16}$in. diameter apparently affords sufficient circulation to prevent further blistering. Moisture measurements in the flue gas by determination of dew point have on many occasions shown that about ½ per cent. of the boiler output is lost by one opening. The maximum leakage occurring at any one time was 2·2 per cent. Analysis of the scale near failures showed it to be much like that in other boilers, consisting of soft, non-scale-forming materials cemented to the tube by hard, scale-forming materials.

Other fin tubes near the failed one were bowed away from the furnace slightly, suggesting that the troubles were not isolated to the one tube.

Anemometer measurements made in the furnace with the unit out of service showed an air shortage through the front wall ports near the side walls, and accordingly a contributing cause for the failure was thought to be due to this air shortage and resulting high heat transfer rates. Air deflectors were installed to make air flow through the front wall ports more uniform across the furnace width. All tubes were turbined, and 25 lb. of boiler compound containing about two-thirds soda ash were inserted in the boiler drums before the next run.

How solids got into the boiler water was a matter of question, for observations for condenser leakage with the condenser shut down, its water box filled with lake water, and an appreciable vacuum on its steam side, disclosed no excessive raw water leakage. It was wondered if dissolved solids in the steam make-up from the low-pressure boilers could probably become insoluble at the higher boiler water temperatures, and not until a turbine test was performed in the latter part of December was the correct cause discovered, as follows:—

Condenser Leakage.

To test the high-pressure turbine it was necessary to isolate it with the high-pressure boiler from the remainder of the station. The water used in the test system was constantly re-circulated, and it was noted that instead of make-up being necessary, as was expected, some water had to be bled from the system. At the same time during the test some electrical resistance readings indicated 2 per cent. condenser leakage. These two observations checking each other showed that the shut-down tests were unreliable, and indicated that the scale found in the high-pressure boiler was due to about 2 per cent. condenser leakage into its feed water. The condenser responsible for the scaling trouble was of single pass design, with tubes packed at one end and rolled at the other. Owing to station design, all high-pressure boiler feed water came from this unit. Adjustment of the tube packings was immediately commenced, but no success was made until in April, when the condenser was entirely re-packed. During the intervening time leakages from ·5 per cent. to 1·5 per cent. occurred, though these records were not taken frequently until an electrical conductivity apparatus was purchased and put into almost daily use.

Period No. 2.

After 726 hours' operation on the next period, making 1600 hours total since new, ten more fin tubes had to be replaced because of blisters or excessive bowing. It was during this period that the installation was operated two weeks continuously after the first failure.

As before, the trouble was confined to tubes near the side walls, presumably because of air shortage still occurring at that point. Improvements in the baffling of the front wall were made until the air flow was positively uniform across the furnace width.

Boiler Tube Failures.

During the same stoppage twenty-eight boiler tubes had to be removed because of blisters or warping. The blisters occurred opposite the top of the first-pass baffle, a point where the sum of the heat transfers by convection and by radiation is a maximum. To equalise the severity of service throughout the length of the boiler tubes the baffle was moved back two rows. The velocity of water circulation in the front row of boiler tubes was increased by installation of bell-mouth entrances and exits in the lower and upper drums respectively. All tubes were turbined, and the boiler put back into service feeling that at least localised overheating would be diminished, but that possibly more failures would occur.

Explanation of the cause of failure by the use of known data of heat transfer rates and metal strengths at long, sustained high temperatures was attempted, to learn if the high-pressure service was imposing conditions requiring use of better metal in tubes exposed to the furnace. Comparison with service conditions at 300 lb. pressure was made, and it was evident that conditions were more exacting because of (1) 150 deg. higher water temperature, (2) 50 per cent. higher metal stress, and (3) slightly higher temperature drop through the thicker metal at furnace heat transfer rates. The following tabulations show the relative stress requirements of high and low-pressure boiler tubing, such as used at Lakeside, and a typical analysis of the low-carbon steel used for boiler tubing in the high-pressure boilers.

Pressure service	300 lb.		.. 1300 lb.
Tubes	Boiler ..	Screen ..	Boiler
Thickness	·180in. ..	·205in. ..	·35in.
Outside diameter	4in. ..	4in. ..	3in.
Stress, lb. per sq. in. ..	3050 ..	2640 ..	4270

Analysis of 1300 lb. Boiler Tubes.

Carbon	·16
Manganese	·43
Phosphorus	·009
Sulphur	·036
Tensile strength	58,000
Yield point	46,000

Long-time Metal Strength at High Temperatures.

Having a metal stress of only 1500 lb. per square inch higher than 300 lb. tubes appeared an inadequate explanation of the high-pressure tube failures until an investigation of long-time tensile strength of boiler tubing at high temperatures was considered. An A.S.M.E. paper by A. E. White disclosed that at 1250 deg. Fah. a sample of low-carbon boiler tubing failed at 213 lb. per square inch stress, and at 1000 deg. his work suggested that ultimate failure at 3000 lb. per square inch stress would probably result. Other data of long-time tests were plotted, and though in great disagreement it was felt that an average curve for low-carbon steel would be reliable. This data indicated that the maximum temperature to which boiler tubing could be subjected without failure was 900 deg., and that it was not necessary that this tubing become red hot to blister.

Results of Calculations.

Calculations covering a range of service conditions as

* The Institute of Fuel, November 24th, 1927. Abstract.

regards heat transfer rates, velocity of water in tubes, and thickness of scale, indicated that 900 deg. tube temperature could occur under actual operating conditions with scale of $^1/_{16}$in. thickness. Following is a sample of one of these calculations, which, if studied, will show the effect of circulation through the tube and that of scale thickness in terms of temperature differences. This table is based upon the heat transfer rate of 46,500 B.Th.U. per square foot, a value realised in actual practice, and determined from the average transfer rate of the radiant heat superheaters and reheater.

Effects of Circulation Velocity and Scale Thickness in Terms of Temperature Difference.

Heat transfer conditions.	Poorest.			Best.			
Velocity of water in tube, ft. per sec.	1	2	4	6	8	10	12
Temperature drop through water film, deg. Fah.	175	100	58	42	33	27	24
Thickness of scale, inches	$^1/_8$	$^3/_{32}$	$^5/_{64}$	$^1/_{16}$	$^3/_{64}$	$^1/_{32}$	$^1/_{64}$
Temperature drop through scale	180	137	114	91	68	45	23
Temperature drop through metal	64	64	64	64	64	64	64
Total temperature drop between water and tube exterior	420	301	236	197	165	136	111
Temperature of water	575	575	575	575	575	575	575
Temperature of external tube metal	995	876	811	772	740	711	686
Assumed maximum long-time strength	2500	4500	6000	8000	8500	9000	9500
Actual stress	4300	4300	4300	4300	4300	4300	4300
Factor of safety	·6	1·05	1·4	1·85	2·0	2·1	2·2

The above calculations correlated with the long-time tensile strength data show how factors of safety of 5 or more calculated in the usual manner diminished to unity or below when calculated for actual service conditions. Conclusions from this analytical work are summarised by stating that a maximum scale thickness of $^1/_{32}$in. can be tolerated, and that $^1/_{16}$in. means a tube failure. This agrees with practice and reconciles test data with actual experience.

Loss of Tensile Strength in Service.

About the same time test bars from the boiler and fin tubes in service at various parts of the installation were prepared and tested for tensile strength to learn if long-time stress at high temperatures had permanently weakened the metal. From reading literature on the subject one could not determine whether strength was lowered temporarily or permanently after being stressed at high temperatures over long periods of time. Samples taken at the front and rear of failed boiler and fin tubes in regions of severe service were found 20 per cent. lower in tensile strength and elastic limit than samples taken from the same tubes near their extremities where heat transfer was low. Samples from the front and rear faces of a rectangular radiant superheater element after service at 300 lb. showed the overheated metal to be one-third lower in both tensile and elastic strength. Crude estimates indicated 200 deg. difference in operating temperature, the front face having a maximum temperature between 900 deg. and 1000 deg. Fah.

From indications of both the boiler tubes and superheater elements there appears proof that an annealing occurs in service which lowers their tensile strength temporarily and considerably below original tensile strength and elastic limit. This is significant when computing factors of safety and tensile strength under actual operating conditions.

Conclusions from Period No. 2.

Conclusions were definite in pointing out that either raw water must be kept from the system and scale limited to $^1/_{32}$in. thickness or that higher strength tubes for high temperatures would need to be substituted for all low-carbon steel tubes exposed to the furnace. Higher stress in 1200 lb. tubes had the equivalent effect of lowering the maximum safe working temperature 150 deg. below that of 300 lb. tubes, and the 150 deg. higher temperature of 1300 lb. boiler water was an additional handicap. These two influences added together showed that for the same heat transfer and water velocity conditions metals having carbon steel tensile strength at 300 deg. higher temperature would be necessary to give results equivalent to those from 300 lb. boiler tubes. Stated in other terms, $\frac{1}{8}$in. thicker scale can accumulate in a 300 lb. tube than in a 1300 lb. one. Greater thickness of metal in the high-pressure tube has the effect of $^1/_{32}$in. thicker scale in a 300 lb. tube.

Cleaning of tubes every 500 hours was shown to be positively necessary unless the condenser could be made water-tight or some means of eliminating scale deposition could be found. It will be remembered that the 300 lb. boilers operate 5000 hours with 3 per cent. raw water make-up with only one cleaning.

Period No. 3.

Accordingly, the next run of 390 hours was made without a failure. The boiler was again turbined and the next run (No. 6) came to an untimely end by failure of a riser tube underneath the arch owing to high heat transfer by combined radiation and unusually high convection. It was felt that the scale situation had nothing to do with this failure, since inspection showed the tube clean and the nearby burner so out of adjustment that its flame impinged directly on the fin tube.

Corrosion Period.

Failure of four boiler tubes only 330 hours after being turbined, and with very low condenser leakage, seemed to upset all previous deductions in regard to preventing scale troubles. It seemed impossible that less than $^1/_{10}$ per cent. condenser leakage would furnish enough solids to cause tube failure through scale formation, if such were the case. Continuous operation of the boiler would be impossible unless some sort of feed water treatment could be used to prevent scale formation entirely.

Inspection of the blisters showed them to be of a different nature from those experienced previously. The bulge was more pointed and had a diameter of only $\frac{3}{4}$in. Moreover, the deposit inside the bulge was apparently of a different nature, being predominantly black in colour and in greater quantities than before experienced. An analysis of this deposit found opposite a failure is as follows :—

	Per cent.		Per cent.
Silica	3·93	..	6·31
Loss on ignition	6·59	..	—
Black iron oxide	53·30	..	71·99
Calcium oxide	24	..	—
Aluminium oxide	12	..	7·06
Calcium hydrate	—	..	8·06
Calcium sulphate	—	..	1·22
Copper oxide	—	..	1·24
Magnesium silicate	—	..	4·15

It will be noted that most of the substance is composed of black iron oxide, obviously the product of an electrolytic corrosion process. In the first analysis a large percentage of scale-forming elements is shown, though in the second one 72 per cent. is black iron oxide.

From the above analyses it was apparent that troubles had changed from scale to corrosion. Whereas previously solids in the raw water had formed a protective coating over the tubes, now localised corrosion occurred because of elimination of raw water make-up without an attendant care in conditioning boiler feed water. An analysis of boiler water taken during this period is as follows :—

	Gr. Gal.
Date	7/1/27
Calcium carbonate	·08
Magnesium carbonate	Trace
Sodium carbonate	1·28
Sodium sulphate	·15
Sodium chloride	·58
Iron oxide and alumina	·03
Silica	·19
Oil	·32
Organic matter	·93
Suspended matter	1·11
Total solids	4·67

Note that it is only very slightly alkaline, and would probably become acid at times. Oxygen measurements taken during the next period before changes to the system were made indicated that ·45 c.c. per litre oxygen existed in the boiler feed water, and the three conditions of low raw water make-up, possibly slightly acid boiler water, and relatively high oxygen in the feed water was undoubtedly responsible for the corrosion.

Though all authorities are not in agreement in explanation of the *rôle* which oxygen plays in boiler tube corrosion, elimination of it to a very large extent is apparently necessary.

Treatment of Feed Water.

The boiler manufacturer suggested treatment of the feed water to maintain an appreciable alkalinity and incidentally to prevent scale formation by providing the presence of a soluble salt which would increase the solubility of scale-forming ones present in the raw water. Tri-sodium phosphate was prescribed for this dual service, and accordingly the next period of operation was started with tri-sodium phosphate introduction in such amounts that a caustic alkalinity of about 200 p.p.m. (parts per million) and a phosphate concentration of about 50 p.p.m. was maintained.

Treatment Periods, Showing Significant Data and Results of Each Period.

Treatment period No.	Boiler water concentration, P.P.M. NaOH.	Na_2CO_3.	Na_2HPO_4.	Na_2SO_4.	Total† solids.	Treatment, P.P.M.*	Hours in service.	Oxygen in feed water, c.c. per litre.	Results. Corrosion.	Scale.	Minimum turbine capacity.
1	185	34	46	0	265	6·23	131·5	·45	Yes	Yes	O.K.
2	138	35	171	437	781	6·08	167·25	·055	No	No	4200
3	80·5	29	82	408	585	3·98	514·75	·03	No	No	6500
4	52	8	40	283	383	2·35	419·5	·03	No	No	6800

* Pounds of chemical per million pounds feed water. † Not including small amounts of silica, oxides, &c.

Before putting the boiler into service 50 lb. of tri-sodium phosphate, equivalent to 22 lb. of the dry salt, since 12 molecules of water exist in the usual product, was inserted in the feed water drum. Since the boiler contains 90,000 lb., the concentration of the dry salt was about 250 p.p.m. Further additions of sodium during operation were made by dissolving it in a drum of condensate each eight hours and allowing the charge to drip into the feed circuit uniformly during the shift.

An average of oxygen readings taken during this run showed the presence of 145 c.c. per litre caused by the necessity of running 200 deg. feed water through a V-notch meter, which, though steam sealed, could not be furnished immediately with sufficient steam to minimise the concentration of air in the steam space above the water. Not until a 1½in. high-pressure steam line was tapped into the top of the V-notch and the water heated to 210 deg. when passing through it was the oxygen content measured at the condenser hotwell maintained at the boiler feed pump suction.

Even before the completion of this run ·45 per cent. oxygen was not thought high when compared with that experienced in the 300 lb. boiler-rooms without the slightest suggestion of corrosion in either boilers or steel tube economisers. Following is a summary of oxygen readings in the 300 lb. section taken at various intervals. Though widely erratic, they will average about 1·0 c.c. per litre, and they illustrate the corrosion prevention *rôle* of raw water make-up when that make-up is allowed to enter all boilers.

Typical Oxygen Readings in 300 lb. Section, c.c. per litre.

	Date. 9/19/24.	9/19/24.	3/30/26.	10/5/26.
Turbine condensate	·53	·30	1·07	·72
No. 2 heater inlet	2·04	·92	—	1·10
Extraction heater condensate	—	—	2·40	—
No. 2 V-notch meter inlet	—	—	1·34	·90
Boiler feed pump	—	—	1·81	·90

Corrosion Failures.

A forced stoppage after 130 hours' operation, when two leaks in the furnace developed, demonstrated the absolute necessity of lowering oxygen below ·45 c.c. per litre. Three fin tubes and seven boiler tubes had to be replaced because of excessive corrosion. In some cases deposits of such magnitude were built up in the tubes during this short time that it was impossible to see through a short length of tubing.

Though only two tubes were leaking, many others contained considerable amounts of black oxide, and opposite this black oxide the ·35in. thick tube would be found diminished to ·20in., and in some cases to ·125in. thickness. Until a method of detecting these attacked tubes by catching the loosened scale when drilling was discovered, it was thought possible that a wholesale replacement of furnace tubes would be necessary. All tubes exposed to the furnace were turbined thoroughly, and a record kept of the amount of scale removed from each. Those with most scale were removed in their proper order until a point was reached where corrosion did not reduce the tube thickness excessively.

Characteristics of Corrosion Failures.

In all cases a deposit of black iron oxide was found at about the same point in the boiler tubes and fin tubes, which occurred at a place where heat transfer was the highest. Wash water used when turbining would appear red until the region of black oxide was entered. It would then turn a dark black, and would remain that colour for several feet until the corroded spot was passed by the cleaner. In the boiler tubes the corroded region was 3ft. or 4ft. upward from the lower drum, and in the fin tubes it occurred just below a covering of refractory previously added to protect the top of the fin tube wall.

Whether this form of corrosion is due entirely to difference in concentration of oxygen or air in the boiler water or is induced by excessive formation of steam bubbles from the metal is not known. It was very apparent that high rates of heat absorption accelerated the process. Rear boiler tubes or the boiler drums were not affected.

Consideration of the problem showed that decrease of oxygen content to $^1/_{10}$ c.c. per litre or lower was positively necessary. This was obtained by adequately steam sealing the V-notch meter and paying attention to the aeration of condensate at the hotwell. Furthermore, in order to eliminate localised corrosion it was thought necessary to provide large areas for general corrosion, and accordingly all boiler tubes were turbined twice and those exposed to the furnace were turbined three times. This cleaning was also thought advantageous toward the maintenance of sufficient phosphate, for reaction with calcium carbonate was attributed as the reason for low sodium phosphate in the preceding run. In order to eliminate oil caused with turbining the tubes, the unit was first boiled out with caustic soda and drained. As a prevention of possible caustic embrittlement the next treatment was started with an addition of sodium sulphate to maintain the sulphate-to-soda ratio recommended by A.S.M.E.

Oxygen.

Obtaining low oxygen at the condenser hotwell presented a considerable problem which had to be solved before the boiler came into service. Test work indicated that the aeration of condensate was a good measure of the degree of vacuum. Approximately 10 cubic feet per minute additional air leakage caused $^1/_{10}$ c.c. per litre more oxygen in the hotwell condensate. The most important and difficult discovery was that of learning that leakage between the hotwell pump packing sleeves and impeller shafts might cause excessive aeration. In one case, tightening of a sleeve by screwing it on to the shaft only one-quarter turn tighter reduced the aeration from ·35 c.c. per litre to zero oxygen. Though the hotwell pump employed had both seals under pressure, it was, nevertheless, susceptible to this latter type of leakage.

Extraction heater pumps having one seal under vacuum were found generally susceptible to excessive aeration, and this pump on the unit serving the high-pressure boiler was taken out of service, and the condensate it ordinarily handled was flashed into the condenser hotwell. Taking this loss of economy was thought desirable as an insurance against oxygen.

Measurement of aeration when starting units showed that hotwell pump discharge condensate contained from 2 c.c. to 6 c.c. per litre of oxygen. No method of eliminating this aeration has yet been found, though tests have shown that the open heaters will de-aerate this water to ·35 c.c. per litre if a temperature of 210 deg. feed water is maintained leaving the heater. A great number of

measurements show ·03 de-aeration in condensate lines between the hotwell and suction of the high-pressure boiler feed pump, presumably because of rusting in this line.

Oxygen readings of boiler feed water show in general that when ·05 c.c. per litre feed water is attained, zero oxygen occurs in the boiler water, though when the feed water contains over $^1/_{10}$ c.c. per litre titrations may indicate ·02 c.c. to ·04 c.c. per litre in boiler water. No oxygen has ever been found in samples of condensed steam. A great number of measurements have shown that it is possible to keep all six condensers in the station delivering less than $^1/_{10}$ c.c. per litre oxygen water, though a daily check and occasional maintenance is necessary.

Loss of Turbine Capacity.

Immediately upon starting the second treatment period, in which boiler water concentration was maintained at an average of 800 parts per million and a maximum of 1100 p.p.m., with additions of tri-sodium phosphate and sodium sulphate, a considerable decrease in capacity of the 1200 lb. high-pressure turbine was noticed. Fig. 1 shows how the maximum delivered output was decreased from 6600 kW to 4200 kW in one and one-half days at a

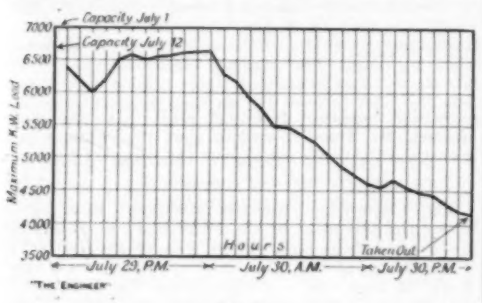


FIG. 1

time when boiler water concentration was highest. During this time the steam flow through the machine decreased only 10 per cent., indicating an efficiency decrease of nearly 30 per cent.

Inspection of the turbine screen showed the presence of a few small white pebbles of water-soluble materials, suggesting that the deposit of boiler treatment compounds on the turbine nozzles and blading could be washed off with water. Accordingly, arrangements were made to inject about 10,000 lb. per hour of water into 15,000 lb. per hour of steam entering at the turbine throttle when the turbine was rotating at about 400 r.p.m.

Immediately upon starting this washing treatment a very strong biting smell of caustic occurred in the region near the exhaust pipe open drains, indicating that the material was being removed in large quantities. Samples of water taken from these drains showed at first a very high alkalinity, though after two hours of washing the water contained only a few particles of solids, supposedly silica. Upon again putting the machine into service it carried full load, proving that most of the deposits upon its blading were water soluble, and probably sodium hydrate, sulphate and phosphate. Subsequent operation with loss of capacity required later washings, and always the full capacity of the machine was regained.

Deposits on Turbine Blading.

On one occasion, when the turbine could be removed from service without loss of station efficiency, it was opened to determine the nature of these compounds coating the blading. An analysis of the white coating was as follows :—

Samples of White Deposit, No. 7 Turbine, August 18th, 1927.

Silica	56
NaOH	23·8
Na_2CO_3	16·3
FeO	3·6
Na_3PO_4	None
Na_2SO_4	None
Calcium	None
Magnesium	None

The presence of a large percentage of silica and total absence of phosphate suggests that condensation of steam during the shut-down process rendered accurate sampling impossible.

Examination of chemical tables indicated that the melting point of sodium hydrate occurs at a temperature existing in about the middle of the turbine, namely, 604 deg. Fah. Inspection had shown that the first ten stages of the machine were free from deposit and the latter half of the unit totally covered with the white deposit. Following are melting points of the compounds resulting from feed water treatment.

	Deg. Fah.
Sodium hydrate	604
Sodium phosphate	170
Sodium sulphate	1700

Chemical tables state that below 604 deg. sodium hydrate is a sticky paste, thus explaining why the latter half of the machine was covered with a composite coating of high-melting-point elements cemented into the hydrate binder.

The pronounced decrease in efficiency on this particular unit was due to the small temperature range through which it works, namely, 720 deg. to 470 deg. Undoubtedly the same kind of efficiency loss occurs in some large condensing machines fed with steam from boilers containing high caustic alkalinity, though the effect upon their overall efficiency might be only 1 to 3 per cent. because of the high energy drop per pound of steam from their throttle to exhaust. Former experience with loss of turbine efficiency generally indicated a drop in steam flow or an increase in stage pressures to carry given loads. In this case loss of output was almost entirely due to decrease of efficiency in the latter half of the machine.

Deposits in Superheater.

To corroborate observations at the turbine, examinations were made of the inside of the superheater elements. Inspection showed a white deposit occurring in the first and second pass elements and none in the third and fourth passes. This agreed with the turbine inspection, for at temperatures much above 600 deg. the material was not present. The superheater inspection was of value only from the standpoint of gaining more knowledge of conditions, for the deposit was of insufficient thickness to cause any trouble, and occurred on the colder parts of the elements. The front faces exposed to the furnace were clean.

All analyses were of materials dissolved off the superheater tubes by water. When concentrated in a small amount of wash water and cooled to room temperature a great volume of crystals formed in the bottom of the container.

Analyses.

	Crystals from wash water, per cent.	Superheater wash water, gr. per gallon.
Sodium carbonate	2·96	2·10
Tri-sodium phosphate	4·32	7·75
Sodium sulphate	89·42	23·88
Silica	2·58	2·50

Obviously, it is not strictly correct to compare these analyses with that of the deposit on the turbine blades, for in the superheater case only the water-soluble portions were analysed, and in the turbine case some water-soluble components had been lost before sampling. It is probable that if one could measure all constituents of the deposits accurately he would find them in much the same proportions as in boiler water, for carry-over from the boiler probably is not selective of material.

Moisture in Steam.

Obviously, a determination of the amount of carry-over from the boiler was an important one at this time of turbine trouble.

Ever since the boiler was originally put into operation efforts had been made to determine the moisture in the steam by calorimeter, though results were not satisfactory, since in many cases they indicated superheated steam in considerable amounts. The calorimeter temperature was considerably above the theoretical zero moisture temperature, and not until several calorimeters were designed and tried could the "normal" temperature at zero steam output be made to appear reasonable.

In view of these unreliable results of calorimeter measurement a method was devised whereby the moisture could be determined with an electrical conductivity apparatus. About 100 hours of moisture readings at two-minute intervals showed the boiler to be delivering about ¼ per cent. moisture, though at times a variation between ·2 per cent. and ·5 per cent. was noted. This percentage moisture was felt good practice for a boiler operating at 300 per cent. rating and at 1300 lb. per square inch pressure. Some engineers have expected considerably poorer results because of the less difference in density of water and steam at higher pressures, but it appears that the smaller size of steam bubbles breaking above the boiler water cause less entrainment of moisture. Fig. 2 shows a

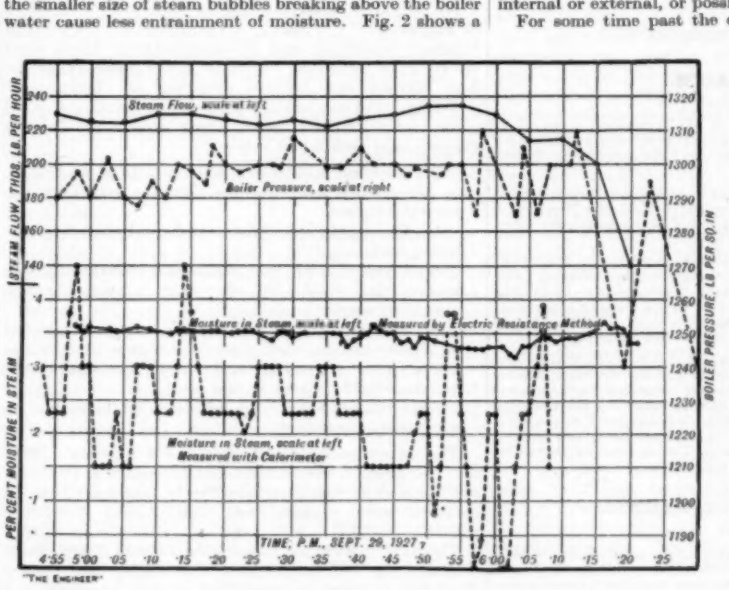

Steam Flow, scale at left
Boiler Pressure, scale at right
Moisture in Steam, scale at left Measured by Electric Resistance Method
Moisture in Steam, scale at left Measured with Calorimeter
TIME, P.M., SEPT. 29, 1927
STEAM FLOW, THOS. LB. PER HOUR
PER CENT MOISTURE IN STEAM
BOILER PRESSURE, LB PER SQ. IN.
"The Engineer"

FIG. 2

few hours of moisture readings when the boiler was being removed from service after treatment period No. 3. Calorimeter moisture indications are based upon a zero moisture temperature so chosen that calorimeter indications about check with the electrical method.

Correction of Turbine Trouble.

Installation of baffles in the top drums and decrease of concentration of solids in the boiler water effected a decrease in carry-over to such a point that deposits on the turbine blading did not collect accumulatively. After washing, a slight decrease of capacity would be noticed in the first few days, and then the efficiency would become stabilised, and would not decrease any further. This is the condition under which the turbine is being operated at present. It is carrying a load of 6800 kW with a water rate of about 36 and an efficiency of approximately 73·5 on the electrical output basis. It appears that the sodium hydrate can bind other solids to the blading to only a certain small maximum thickness when boiler water concentration is low. Information that sodium phosphate has ten times the effect of sodium sulphate in inhibiting caustic embrittlement may allow discontinuance of treatment with sodium sulphate, and thus so lower boiler water concentrations that no effect upon the turbine capacity will occur.

Scale and Corrosion Prevention with Low Boiler Water Concentration.

Two inspections have recently been made after periods of operation of approximately 450 hours each with less than 400 parts per million total solids, 70 p.p.m. of which were hydrate concentration and 60 p.p.m. phosphate. Drilling of many tubes with no signs of corrosion, and practically zero scale, proved that the above low alkalinity and phosphate concentrations are totally effective in preventing corrosion and scaling. Less than a thimbleful of refuse could be obtained from a 20ft. tube exposed to the furnace after 900 hours' operation. Most of this very small material consisted of iron particles loosened by the hardened steel cutters of the revolving cleaner. It is conclusively believed that presence of phosphate will so prevent scale formation that runs of indefinite length without stoppage can be made. On the basis of these last two inspections it is expected that the boiler will never again be cleaned.

Economy.

A weighed water turbine test was made after two months' operation. It indicated an efficiency ratio of 75½ per cent.—computed on energy available from line to exhaust pressure and on electrical output. Seal leakage from 1200 lb. to 300 lb. was only ·9 per cent. Inspection of the blading on two occasions has shown the very thin edges of buckets to be worn slightly, though not to such an extent that replacement for several years will be necessary. Use of high chromium blades instead of the present nickel steel ones will prevent this condition.

Completion of the turbine test was all that was necessary to show the value of the higher pressure. Station calculations have shown a minimum of 12 per cent. difference between the efficiencies of the 300 lb. and 1300 lb. section. In one month's operation high-pressure steam put out 33 per cent. of the station output and improved overall station economy 4 per cent.

Finally, it may be said that, though higher pressure puts more exacting requirements upon boiler materials, safe and continuous operation is positively possible. Desirable reaction to feed treatment is proved, and no conditions have occurred which were not corrected satisfactorily. There is every reason to believe at present that the unit can be kept in service as long as desired, and an order for an additional 1300 lb. equipment will soon be placed.

ENGINEERING PROJECTS AT OSAKA.

Three big engineering undertakings are being planned for Osaka, the commercial metropolis of Japan. One is to improve its harbour, the next to construct an underground and overhead tramway system for rapid transportation of traffic, and the last to construct an air port for international traffic.

Together these ambitious undertakings call for the huge expenditure of 330 million yen during the next ten years. This money will have to be found by floating loans, either internal or external, or posaibly both.

For some time past the ever increasing traffic on the streets has engaged the attention of the municipal engineers. A careful survey of conditions at Osaka and a study of municipal traffic in American and European towns have convinced the local authorities that the congestion problem can only be solved by constructing a modern system of rapid tramways across the city, both underground and overhead. Work on this undertaking is due to begin next year and to be completed in ten years. The distance traversed by the new lines, which will run from East to West and from North to South, will be about 34 miles. The most important section of the whole system will be a subway connecting the main railway station in the northern part of the city with a busy suburban tramway terminus in the southern part. The less important section in the outskirts of the city will be crossed by an overhead line. The whole system will cost about 126 million yen. A considerable part of the material and machinery required will have to be obtained from abroad.

It is the ambition of the citizens of Osaka to make the town an up-to-date seaport as well as a thriving centre of international commerce. The city already has a harbour which cost 42 million yen to complete. The plan now under consideration includes improvements and enlargements, costing altogether 200 million yen. A new quay 440 m. long and 220 m. wide will be constructed to replace the present pier, which has become decayed. In addition, eight quays will be built on the southern side of the port, each 365 m. long and 155 m. wide. When all are completed, Osaka will have a harbour able to accommodate alongside eighteen vessels of from 10,000 tons to 15,000 tons each.

As regards air transport, the Japanese Government recently decided to establish three main air ports: one at Tokio, one at Osaka, and one at Fukuoka. The Osaka air port will be constructed near the harbour and will cover about 50 acres of open space, part of which is now under seawater and will have to be reclaimed. Work on this undertaking, which is to be carried out by the Imperial Government, though the land required is owned by the Osaka Municipality, will start shortly and will be completed by the end of next March.

A new area, thought to be extremely rich in lead, zinc, silver and gold, has been discovered in Northern Manitoba.

THE INSTITUTION OF CHEMICAL ENGINEERS.

The Institution of Chemical Engineers has arranged to hold a series of meetings on the evenings of Wednesday, Thursday and Friday, December 7th, 8th and 9th. All the sessions will be held at the Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1.

On the Wednesday there will be one session only, at 5 p.m., when the President, Sir Alexander Gibb, will take the chair, and Mr. Norman Swindin will read a paper on "Submerged Flame Combustion."

The two sessions on Thursday, December 8th, will be devoted to a discussion on Refrigeration, under the Chairmanship of Mr. J. Arthur Reavell, Vice-President. Three papers will be read at 5 p.m., as follows:—(*a*) "The Design of Refrigerating Plants," by Mr. G. W. Daniels; (*b*) "The Practical Aspect of Refrigeration as Applied to the Chemical Industry," by Mr. Leuig Chew; and (*c*) Electrical Automatic Refrigerators for Domestic Use," by Mr. Raymond Mitchell.

After an adjournment for dinner at 6.45 p.m., the discussion on these papers will open at 8 p.m.

On Friday, December 9th, at 5 p.m., with Mr. W. A. S. Calder, Vice-President, in the chair, Mr. W. J. Jones will read a paper entitled "The Problem of Industrial Lighting, with Some Reference to the Chemical Industry." At 8 p.m. on the same evening, Mr. William Macnab presiding, two papers will be read:—(*a*) "Continuous Weighing of the Contents of Vessels: the 'Weighmeter,'" by Messrs. R. G. Parker, D. N. Jackman, and J. N. Vowler; and (*b*) "The Properties of Silica and Fireclay Refractories in Relation to their Industrial Usage," by Mr. A. T. Greene.

Application for admission to any particular session should be made to the hon. secretary of the Institution on or before Friday, December 2nd.

B.E.S.A. SPECIFICATIONS.

ROUND STRAND STEEL WIRE ROPES.

The British Engineering Standards Association has just issued a British standard specification for round strand steel wire ropes for colliery winding purposes. This specification has been prepared by committees' representatives of both the buying and manufacturing interests, and it will, as in the case of all British standard specifications, be reviewed as experience of its working or progress in the industry renders it necessary, and revisions issued from time to time. Specifications for lift ropes and for colliery haulage ropes are also in hand by the committees, and will be published as and when they are completed. Copies of this new specification—No. 300, 1927—may be obtained from the B.E.S.A. publications department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. each post free.

CONTRACTS.

The B.E.N. Patents, Ltd., of 92, Tottenham Court-road, London, W. 1, has received orders for B.E.N. car washing plants from the Corporations of Portsmouth, Plymouth, and Southampton.

The General Electric Co., Ltd., of Magnet House, Kingsway, London, W.C. 2, has received from H.M. Air Ministry, a contract for the supply of Osram gas-filled lamps for the three months beginning October 20th, 1927.

The Westinghouse Brake and Saxby Signal Company, Ltd., has received an order from the Baddesley Collieries, Ltd., for a complete pneumatic decking plant for the Baddesley No. 3 Pit Top, including, in addition to the decking apparatus, automatic gates, control of drop cage, and control of keps; also scotch blocks and kep control for the low "landing" level.

Alfred Herbert, Ltd., of Coventry, has received instructions from N.V. Provinciale en Gemeentelijke Electriciteits Maatschappij, Amsterdam, to put in hand a further four Atritors, making sixteen Atritors in use and on order for the Centrale Noord Station at Amsterdam. These machines will each have a pulverising capacity of 8000 lb. of coal per hour, and will be driven in pairs by steam turbines. This is believed to be the largest single installation of unit pulverisers in Europe.

A Re-designed Capstan Lathe.—In the article in last week's issue describing Messrs. Alfred Herbert's re-designed No. 4 capstan lathe we stated that the machine absorbed 5 horse-power in its drive. Messrs. Herbert hold that this statement is open to misconstruction. Five horse-power, they state, is the maximum that need be provided. On heavy work the machine is sufficiently rigid and robust to transmit 5 horse-power or more, but on ordinary work very little horse-power is absorbed in the drive. One 5 horse-power motor is, we are informed, quite sufficient to drive three of the machines arranged for group driving from a line shaft running on ball bearings.

The British Electrical and Allied Manufacturers' Association.—On Thursday, November 17th, the annual dinner of the British Electrical and Allied Manufacturers' Association was held at the Connaught Rooms, when the President, the Earl of Derby, presided. In proposing the toast of the future of power supply in Great Britain, Lord Weir said that the Electricity Act of 1926 was passed with the most complete faith in the progress of Great Britain in a productive sense. The Act had been criticised because it did not affect distribution, but, as a matter of fact, it did help distribution, because it set engineers free to attend to that side of the business. The Central Board was incurring heavy expenditure on transmission lines, because it had faith in the future demand of the country, and a similar policy ought to be adopted by the distributors. If electricity remained costly in the future, it would only be because of an insufficient demand. In replying to the toast, Sir Andrew Duncan, Chairman of the Electricity Board, said that electricity must play a decisive part in the resuscitation and expansion of British industry. Savings, even of fractional parts of a penny per unit, were vital, because of the spur they were to efficiency within the industry itself, and also because of the cumulative value in the mass to the producer. He thought that the private user of electricity had begun to feel that it was wrong and unprofitable to add the production of power to his other business worries. The toasts of the guests was proposed by the chairman and Lord Gainsford, president of the Federation of British Industries, replied; whilst the toast of "The Chairman" was proposed by Colonel R. K. Morcom.

The Public Works and Transport Congress.

No. II.*

The sessions of the Public Works, Roads and Transport Congress were continued on Wednesday, November 16th, at the Royal Agricultural Hall, Islington.

In the morning there were Conferences arranged by the Institution of Municipal and County Engineers at which the following papers were considered:—(*a*) "The Organisation of Highways Work," by Mr. B. Price Davies, Surveyor of Works to the Cardiff City Council; and (*b*) "Rural Simplicity," by Mr. R. O. Goodby, Surveyor to the Henley (Oxon) and to the Hambleden (Bucks.) Rural District Councils.

Of Mr. Price Davies' paper all that need be said is that it was divided into four parts, the first three of which were entitled respectively as follows:—"Registration of Highways," "The Inspection of Highways," and "Preparation," while the fourth, which dealt with the period of actual execution of work, was supported by four appendices, as follows:—(*a*) Instructions to District Foremen; (*b*) Concrete Roads; (*c*) Outline of Scheme for Snow-clearing; and (*d*) Expenditure on Tar-spraying on Carriageways.

Mr. Goodby in his paper began by saying that the importance of rural roads was becoming generally recognised, and remarked that the time of the Congress would not be wasted if rural surveyors were given the opportunity of airing their opinions.

From the economy point of view alone, it was essential for the rural surveyor to be economical. He had not command of the large revenue of the wealthy counties and boroughs, and had the more difficult problem, say, of making a road for £1000 rather than £10,000 per mile. He had no opportunity to develop an extravagant mind—which was, perhaps, as well—for it might seem to the ordinary man in the street that some surveyors had got beyond considering schemes that would cost less than tens of thousands of pounds.

The rural roads of to-day were the main roads of the future, or at least the foundations of them, and just as the foundation was the key of a successful road, so the rural surveyor was the key man of the profession. It was much less costly to make a road ahead of the traffic, and the work of a rural surveyor should save future rate and tax payers large sums of money.

Mr. Goodby, after dealing in turn with "Grading of Highways," "Policy," "Complaints," "Omnibus Routes—Widening and Reconstruction," then went on to give accounts of some experiments that he had carried out before deciding on bituminous grouting. He explained that certain lengths of road were laid with local stone—dug gravel or Thames gravel—and treated as follows:—

(*a*) Grouted with quick-setting cement and sand, in accordance with the specification issued by the manufacturers.

(*b*) The aggregate, cement and sand, mixed before being laid.

(*c*) Grouted with fine chalk and silicate of soda, in accordance with the specification issued by the manufacturers.

(*d*) The chalk was mixed with the partly rolled aggregate on the road, and the silicate of soda was put into the water cart and the whole consolidated as an ordinary water-bound road.

(*e*) Grouted with cold emulsion of bitumen, as previously described.

The experiments were carried out in June, 1926, and the lengths were bituminously sealed in October, not because it was then absolutely necessary, but to make it more certain that they would stand the winter.

The author went on to say that he was chary about commenting on proprietary materials, but feeling that his experience might be useful, he gave the following extracts from his notes on the work:—

The conclusions he arrived at were that:—

(1) For cement work nothing larger than 1½in. material should be used, and that the coat should consist of material graded down to sand.

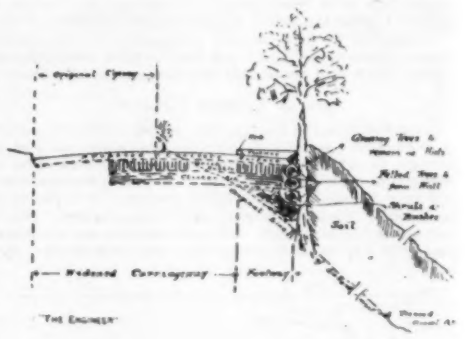
(2) Pre-mixed cement concrete was better than grouting with cement, and that rolling was not so good as tamping.

(3) The proportion of chalk in silicate of soda grouting could be reduced.

(4) The cost induced him to proceed with bituminously grouted material.

Mr. Goodby then proceeded to describe two ingenious expedients to which he had resorted in case of need. In one he had used old bitumen drums to serve as walls of soakaways in lieu of brickwork. In the other case, the problem to be solved presented itself because a disused gravel pit had been excavated much too close to the highway. There were substantial trees and shrubs growing on the slopes of the pit, and those standing inside the line of a proposed widening were left to act as posts for a retaining rampart. The smaller trees were felled and laid against the growing ones to form the wall, and the shrubs and hedges were placed on the roadside. Soil from other widenings was rammed in and beyond the retaining barricade. Clinker and brick rubble formed the lower foundation of the area added to the carriageway, and the upper foundation of cement concrete would, it was explained, be laid on the whole width of the carriageway at that point.

A sketch, which we reproduce, was given to explain this "rural" method of saving the cost of a very



expensive concrete retaining wall. It was anticipated, Mr. Goodby added, that this work would withstand the traffic for at least the period of the loan.

The Conferences for the afternoon were again under the direction of the Institution of Municipal and County Engineers. There were two papers:—(1) "The Design of Deep Culverts," by Mr. C. S. Chettoe, Assoc. M. Inst. C.E., of the Roads Department of the Ministry of Transport; and (2) "The Design and Construction of Reinforced Concrete Conduits, Sewers and Aqueducts," by Professor E. R. Matthews, M. Inst. C.E.

Mr. Chettoe's paper had been awarded the first prize of a Gold Medal and £50 in the open competition arranged by the Congress Committee. It is a long and largely mathematical treatise, supplemented by tables and drawings, and it does not lend itself to condensation; it should be read and considered as a whole. It may be explained, however, that the subject is dealt with under the following headings:—I. "External Forces Acting on a Deep Culvert;" II. "The Elastic Theory and its Application;" III. "Method of Obtaining Stresses on a Cross Section;" IV. "The Line of Pressure;" V. "Economy of Culvert Types for Different Conditions;" VI. "Longitudinal Stresses;" and VII. "Method of Design."

Professor Matthews' paper, while not of quite such a mathematical nature as that of Mr. Chittoe, is even more profusely illustrated, and equally impossible to compress. It is divided and subdivided as follows:—"Historical Note: (*a*) 'Conclusion as to Bond Strength,' (*b*) 'Mechanical Bond,' (*c*) 'Hooked Ends';" "Use and Advantage of Reinforced Concrete;" "Properties of Reinforced Concrete: 'Properties of Cement,' 'Concrete—Broken Stone, Gravel, &c.—Aggregate,' 'Concrete—Sand,' 'Proportions,' 'Weight of a Cubic Food of Cement';" "Design of Sewers—Sewer Sections: 'Circular Sections,' 'Egg-shaped Sewers,' 'Horse-shoe Section,' 'Catenary Section,' 'Semi-elliptical Section.'"

On the Thursday morning there were two separate Conferences, one arranged by the British Waterworks Association and the other by the Association of Managers of Sewage Disposal Works. For consideration by the former there were the three following papers:—"River Pollution," by Mr. F. H. Heald, Clerk to the Board of Conservators, Trent Fishery District; "The Law Relating to Rivers Pollution Prevention," by Mr. A. Bebbington, Assistant Clerk and Solicitor to the West Riding of Yorkshire Rivers Board; and "Colloids," by Mr. T. P. Francis, Assoc. M. Inst. C.E., City Surveyor and Water Engineer of Bangor.

Mr. Heald, after some introductory remarks, went on to say that, within the fishery district in which he had the pleasure of working, that of the watershed of the river Trent, which extended to an area of more than 4500 square miles, were included such important centres as Birmingham, Wolverhampton, Walsall, Leicester, Nottingham, Derby and Burton-on-Trent, and such busy industrial districts as the Leicestershire and the Nottinghamshire and Derbyshire coalfields, the Potteries and the Black Country. There were, he estimated, at least 10,000 pollution sources. Many of them were constantly active, while others were intermittent in action. These pollutions might be divided, roughly, into three groups, the effluent from sewage treatment works, crude sewage outfalls, and industrial waste outfalls, both individual and collective. There was a fourth group, of course, that ever-present, all-pervading pollution which arose from the waste oil and disintegrated tar which was washed in wet weather from roads, but that, to his mind, was a separate problem altogether, and he did not, he said, propose to attempt to deal with it now. Generally speaking, the effluent from a well-designed and well-managed sewage disposal works of any kind was not definitely poisonous to water

* No. I. appeared November 18th.

life, though the low free-oxygen contents of the majority of such effluents made them a very definite factor of deterioration in that direction to the streams into which they found their way.

Even if a sewage works effluent were kept always up to the standard which was recommended by the Royal Commission on Sewage Disposal, it did not necessarily follow that it was not of such a nature as to make it come within the provisions of Sec. 8 of the Salmon and Freshwater Fisheries Act, 1923. Among sewage engineers there appeared to be an impression that so long as the recommendations with regard to proportionate dilution, and so on, which were comprised in the last report of the Royal Commission, were carried out, they were relieved of all responsibility. In thinking on those lines they were overlooking the fact that that report, and others issued by the Commission, had not at the present time, nor have ever had, any statutory force or value, and that while no doubt the Drafting Committee of the Salmon and Freshwater Fisheries Bill had before it all those reports and the recommendations which they contained, Sec. 8 of the Act was so framed as to make it, for the first time in English law, quite definitely an offence to put into any water containing fish or any tributary thereof, any liquid or solid matter not only to such an extent as to cause the waters to be poisonous or injurious to fish, but also which might injure the spawning grounds, spawn or food of fish.

However well fish of certain varieties might be able to survive in waters of low free-oxygen contents, such a condition was not only injurious, but actually deadly to fish spawn and to many of the links in the chain of water life which comprised the food of fishes, and that appeared to be the object of the extension of legal responsibility in that direction. The volume of the effluent by comparison with that of the stream into which it flowed had an important bearing on that aspect of the matter as had that of the amount of pollution which the carrying-away stream already had to bear.

There were many sewage disposal works which were so well equipped and so efficiently managed that the effluent from them was literally up to "drinking water" level, but there were others—many others, he was sorry to say—which, though they possessed equal possibilities, were allowed to fall to such a low level of efficiency that they became definite pollution factors. A desire for economy on the part of the authority might be the cause of such conditions, but, more often, it arose, he was convinced, from nothing more than a lack of those qualities of goodwill and sense of responsibility or a lack of those qualities plus some individual slackness on the part of those in charge. In such cases, certainly, the remedy did not lie in the direction of finance.

The author then went on to quote an example. Recently the attention of a small local authority was drawn to the fact that its new sewage treatment plant —erected, by the way, at a cost of something like £80,000—was not functioning properly, and that a considerable volume of crude sewage was finding its way into a nearby river, a noted trout stream. It needed four letters written at intervals extending over a month to elicit any response. When it came, it intimated that, after a belated investigation, the statement as to the conditions had been found to be quite correct, and that the man in charge of the works had been discharged as a consequence. But there had been more than a month of this serious pollution, and both its existence and its continuance was due to nothing but sheer slackness on the part of both the authority in question and its servants. That, remarked Mr. Heald, was not by any means an isolated case. He could quote many others of a similar nature.

The author, after having given further instances of carelessness, and discussing the effects of trade waste and other difficult problems, including the treatment of effluent from beet sugar factories, concluded by saying that in thus reviewing briefly his own recent experience of water polluting factors and their causes, he had tried to show that while there might be some which it was possible to look upon as more or less inevitable, they were relatively few, and even their inevitability was not necessarily constant and perpetual.

The heedless fouling of waters for their own selfish or greedy ends by either communities or individuals could not be considered to be other than a crime against society, and, as such, he submitted that it was a thing which should have disappeared a hundred years ago, along with the many other social crimes, born like it of greed, which defamed our national life at that and in earlier periods of our history—slavery, for example. It was an anachronism in this second quarter of the twentieth century!

But it was a crime which he feared would remain in evidence here and there in those areas in which, both as regarded communities and individuals, the tide of civilisation lagged always a little behind the general trend, and would disappear altogether only when general public opinion became alive to the falsity of any claim to justify its continuance.

Mr. Bebbington began his paper by saying that the prominence given to the question of rivers pollution prevention during recent months made the present an opportune time to discuss the existing law on the subject. It would be recollected, he said, that in February last a deputation, representing a variety of interests, waited upon the Lord President of the Council, Earl Balfour, K.G., to press upon the Government the urgent need for dealing with the progressive pollution of rivers. The reply of the Lord President could not be considered wholly satisfactory, because, while recognising that the evil existed, and to a certain extent agreeing with the actual remedies proposed—viz., the appointment of a Central Authority, with the necessary complement, the setting up of Rivers or Watershed Boards for all the rivers of England and Wales—he suggested that before further powers were granted, greater research was required in order to ascertain the most efficient methods which might be adopted for purifying sewage and manufacturing refuse. Scientific research must go on, but, it should be remembered, that save in exceptional cases, the disposal of sewage and manufacturing refuse, so as to prevent pollution, did not now present a very serious problem.

He proposed, he said, to deal with the matter in three parts—first, at common law; secondly, to give a summary of the statute law affecting the subject; and thirdly, to enumerate the authorities which had been entrusted with the enforcement of the law relating to the subject.

This, again, was a paper which should be read as a whole, and we shall not attempt to abridge it.

Mr. Francis, in his paper on "Colloids," began by saying that the use of the term colloids would in most cases instantaneously produce in response the word clay—the epitome in the popular mind of colloids as a class. The term signified that which was sticky or glutinous. A mixture of clay and water, on standing, formed a sediment and a more or less clear liquid layer. That upper liquid layer did, however, contain a certain amount of clay, and that clay was in colloidal solution. If we added some common salt to such a clay solution, down would come the clay. That action of salts on colloidal solutions was very common. Clay and organic matter was carried down by rivers in colloidal solution to the sea. The salt there precipitated it and we had a delta and mud flats. A solution of sugar or salt, however, was a very different thing from a clay solution. On standing, the clay slowly deposited from a clay solution, the rate of deposit being considerably accelerated by the addition of salts. Sugar or common salt solutions, on the other hand, remained permanently so. The difference was that between a suspension and a true solution. In the former case it would seem that the attraction of one water molecule for another was greater than the attraction of a water molecule for a clay molecule. That mutual attraction of the water molecule could be imagined to resist mixture, to force out the clay from the water interstices, and to cause the precipitation of the clay. The same applied to a mixture of paraffin and water, an apparent or "pseudo-solution" being created by vigorously stirring the mixture, the paraffin, however, soon forming itself into a supernatant layer on the water. It might be said that, in true solutions, the affinity of solvent for solute exceeded the affinity of the solvent for its own molecules.

It had been determined that colloids were primarily "diphasic;" they consisted of a dispersion of finely divided matter in an enveloping mass of some other form of matter. . . . Clay, milk, and gelatine were all examples of colloidal solutions; fog was another. Charcoal was a colloid, with charcoal as a continuous phase and air as a disperse phase. A characteristic of colloids was the large extent of surface presented by one phase to the other. If a given solid were taken and progressively subdivided, the total surface area of the particles would increase enormously relatively to that of the original solid.

After dealing successively with "Sols," "The Ultra Microscope," "Brownian Movement," "Electrolytes," "Protective Colloids," "Adsorption," "Surface Tension," "Gels," and "Sedimentation," the author concluded by saying that coagulation processes needed to be very finely adjusted with full cognisance of colloid principles if consistently good results were to be achieved. The efficient working of mechanical filters could not be divorced from the proper precipitation of gel on the sand surface. Rapid filtration or pre-filtration was an application of selective adsorption. Sterilisation, chlorination, base-exchange, the removal of iron bacteria which affected mains and softening processes were all in some way or another influenced by colloidal phenomena. There could, he added, be no doubt that momentous consequences would be an inevitable result of the extensive investigations into colloid characteristics which were now everywhere proceeding. His superficial summary would have served its purpose if it aided water engineers to a clearer grasp of whatever information came to be published or if it enabled them to embark upon a study of the subject with a measure of confidence.

For the conferences arranged by the Association of Managers of Sewage Disposal Works there were two papers: (*a*) "The Solution of Oxygen in Sewage," by Mr. A. S. Parsons, M. Inst. C.E., Borough Surveyor of Reading, and Mr. H. Wilson, Chemist at the Reading Sewage Disposal Works; and "Some Methods of Analysis of Sewage and Water," by Messrs. F. R. O'Shaugnessy, C. H. Hewitt, and A. S. Miller.

The first paper contained an account of experiments which had been undertaken in the hope of getting information as to whether depth has any influence on (*a*) solution of oxygen from diffused air, and (*b*) the actual efficiency of purification by means of activated sludge.

Two concrete pipes, 18in. diameter, were erected side by side on a concrete base, one pipe being 7ft. in total depth, whilst the other had a total depth of 25ft. The bases of the pipes were conically shaped in cement to the diffusers, so that there could be no deposition of sludge except on the diffusers themselves. The diffusers were of the standard porosity made and supplied by Activated Sludge, Ltd. Each diffuser had a total porous surface of 27·7 square inches.

The diffuser ratio in each case, i.e., ratio of diffuser area to the cross section of the pipe was 1 : 9·2. The tall pipe was filled to a depth of 22ft. 6in., whilst the short one was filled to a depth of 6ft. 6in.; thus the tall pipe had a working depth of 3·46 times that of the short pipe, and whilst the tall pipe held 245 gallons, the short one held 69 gallons, the ratio of capacities being 3·55 : 1. Tappings were provided every foot of depth, so that samples could be drawn from any depth.

The air supply to each pipe could be easily adjusted by means of a micrometer screw needle valve and the air was measured at the surface of each pipe by means of a funnel connected to a gas meter. In order that the measurements of air should represent the actual supplies and not merely the effluent or unabsorbed air, the adjustments were always made on the previous filling when the contents of the pipes were purified or completely saturated with air. During settlement and running away of effluent the air was turned off at the main, leaving the micrometer valves ready adjusted for the filling under test, and the supplies were checked during the test whenever variations in the pressure in the air main made it necessary.

The air supplies were actually delivered to the gas meter under a head of 2in. of water. This was ensured by immersing the funnel to that depth below the surface. The gas meter discharged to air so that very little correction, if any, was necessary to get the exact air supply, and they had ignored that correction since the tests were all comparative ones.

The amounts of oxygen in solution at various intervals of time were determined by Miller's method, which, although very rapid and convenient, required care when there was much colloidal matter present, as in sewage or in the early stages of purification tests.

It was noticed that the samples drawn from the bottom of the tall pipe, through the side tapping, always came out full of minute bubbles of gas, like soda water. It was suspected, of course, that such samples could not give accurately the dissolved oxygen figure for the contents of the pipe at that depth, and, in order to test that, a depth sampler, constructed as described by Greenfield and Mickle in the Illinois State Water Survey Bulletin No. 16, was lowered inside the pipe. The samples thus taken from the inside proved to have even higher oxygen content than the samples drawn into bottles through the side taps. The drawn-off samples were then accepted as accurate, and much time was spent on estimations, all of which indicated that there was very much more air in solution at the bottom than at the top of the tall pipe, and that saturation progressed upwards.

When the experiments were repeated to verify them, the authors acted on their still lingering suspicions and turned up the bends screwed into the taps and added tees, so that the actual high-pressure jet of liquid through the valve emerged beneath a short column of liquid. It was found that the samples were delivered quietly into the bottles and that there was no soda water effect. The samples thus drawn from the deeper layers were found to contain little, if any, more oxygen than the upper portions. Doubt, remarked the authors, was thrown on the Illinois depth sampler, but the point of interest which emerged was that it would seem that to project water under pressure into air and against some solid object was a very rapid method of getting oxygen into solution.

With regard to purification by activated sludge, the authors remarked that their experiments on rates of air admission in relation to time of purification were only just commencing, but that they might remark that the results they had so far obtained seemed to suggest that for every design of plant there might be a certain optimum rate of air supply which could efficiently be utilised, and, if the optimum rate were much exceeded, waste of air and power resulted, while, if the optimum rate were not applied, waste of time would result. A useful figure for comparison could be obtained by multiplying the time in hours for complete purification—or equal purification—by the number of cubic feet per gallon. The purification curves and the dissolved oxygen figures seemed to show that the depth in the case of the tall pipe was, if anything, an advantage. They found, however, that there was one effect produced, presumably by the extra depth. Whilst the sludge from the short pipe settled without difficulty, they almost invariably had great trouble with the settlement of the sludge from the tall pipe. Sometimes even in a few minutes after removal from the pipe, or even on ceasing to aerate, the whole of the sludge would rise to the surface, being buoyed up by minute bubbles of gas adhering to the sludge flocks. That trouble seldom

occurred in the short pipe and never to the same extent as in the tall one. Much more study of this point was, the authors urged, necessary, but they might warn other workers contemplating the installation of deep tanks that, whilst such deep tanks might be quite as efficient oxygenation and agitation units as shallow ones, there were some unknown possibilities which might present grave difficulty.

The paper of Messrs. O'Shaugnessy, Hewitt and Miller consists largely of references to methods of analysis proposed by various investigators, and one of its avowed objects is to furnish some evidence in the shape of results obtained by different methods as a contribution to the perennial debate as to the merits or demerits of existing methods. It contains tables of results obtained, but no comments on them are given.

(To be continued.)

Modern Portland Cement Plant.*

By HAL GUTTERIDGE.

BEFORE considering in detail the individual units of a modern cement plant, a brief survey of the processes that take place during the manufacture of Portland cement may be made.

Raw Materials.—In the manufacture of Portland cement a variety of raw materials is used, which may be classed under two general heads:—(1) Calcareous and (2) argillaceous. In the former lime predominates, and in the latter silica and alumina are in the greater proportion.

THE MANUFACTURE OF PORTLAND CEMENT.

The materials pass through three departments:—(*a*) Preparation of the raw materials; (*b*) burning; and (*c*) grinding.

There are two processes by which Portland cement is manufactured. These are known respectively as "wet" or "thick slurry" process and the "dry" process. They differ only in the treatment of the raw materials. All the plants in this country, except three or four, are operating on the wet process; but in America many Portland cement plants use the dry process.

Burning Plant—Kilns.—The type of kiln in universal use in modern practice is the rotary kiln, which, by its greater economy and ease of control, has superseded the fixed continuous kiln. The raw materials, either in the form of slurry or "meal," are fed into the kiln at the higher end, travel slowly down the length of the kiln by means of its rotation and downward inclination, and emerge at the firing end in the form of clinker to fall by gravity into the "cooler."

Fuel for Firing the Kilns.—The fuels used for firing rotary kilns are pulverised coal, oil and gas. Of these, the most frequently used is pulverised coal, mainly on account of its advantage in price; but gas in particular, and oil to a lesser extent, have the advantage that they mix with the air supplied for combustion much more readily than pulverised coal. Further, neither gas nor oil contaminates the clinker with ash to the same extent as coal does. In this country coal is invariably used, but in other countries all three fuels are employed.

Quarrying: Removing Overburden.—In practically all deposits there is an overlay of soil which may be from 6in. to 5ft. thick. In order to remove this overburden suitable tools have to be provided, and in some cases mechanical diggers, which are ordinarily used for digging the raw materials, can be economically used for this work also.

Excavating Tools.—For digging soft chalk, marl, clay and similar soft materials, the most useful kind of tool is a mechanical navvy, which may be operated by steam, oil, or electricity, and is generally mounted on caterpillar tracks, and should be capable of revolving in a complete circle. The navvy digs the material and places it direct into the raw material trucks. When the raw materials are too hard to be dug directly, they are first blasted and then picked up by a digger or grab and jib-crane, and placed in the trucks. For very soft materials, such as clay or mud, a chain bucket excavator may be found to be the best tool. When clays and mud lying under water have to be gained, a grab is generally used, sometimes mounted on a pontoon. The choice of the tool will be governed by the conditions and the labour involved in its operation.

Crushing: Hard Materials.—When crushing hard materials such as limestone and hard chalk, which are generally received from the quarry in lumps up to 2ft. in size, the first treatment is to reduce them to 1½in. size by passing them through two crushers in series. Two types of crushers are used, the "gyratory" and the "toggle joint open-jaw" crusher.

Soft Materials.—Materials such as soft chalk, marl, clay, &c., are usually passed through kibbling rolls and then go direct into a washmill where they are reduced, with the addition of water, to a slurry. A typical machine is composed of two opposing and interspaced sets of curved toothed star-wheels which break up the materials in preparation for the wash-mill.

Wash-mills.—Wash-mills are generally of the harrow type with the harrows slung on chains suspended from a number of radial arms which revolve in a horizontal plane. In the sides of the wash-mill are slotted screens, the width of the slots being generally from ¼in. to ⅜in.; through these all the slurry must pass.

With soft washable materials, and when the quarries are some distance from the preparation plant, it is often more economical to roll and wash the soft materials into a slurry and pump them the required distance. In some of the plants in this country the slurry is pumped as far as 3½ miles. In suitable cases, it is possible to pump for this distance without having too high a pressure in the pumps and without the use of "booster" pumps, but this necessitates the use of a high percentage (about 70 per cent.) of water in the slurry. The finished mixed slurry as fed to the kiln will have from 34 to 45 per cent. of water, so that in the case of clay slurry containing 70 per cent. of water mixed with the chalk in a wash-mill, it may be possible, depending on the proportion of chalk to clay, to dispense with what are termed "settling backs." These are large tanks into which the thin slurry is pumped and which allow the water to run off as the particles of chalk or other material settle down. Weirs which can be raised or lowered are arranged at one end, and, by gradually lowering them, water free from the material can be drawn off.

Storage.—After having been crushed to 1½in. and less, the hard materials are passed to storage bins. These are usually built of reinforced concrete and are of a capacity sufficient to hold about three days' supply. Raw materials in the form of slurry are stored in tanks generally built of concrete, and to prevent settlement taking place it is necessary to supply apparatus which will keep the slurry in a properly mixed condition. There are two satisfactory methods of doing this, the pneumatic and the mechanical methods. In the former, compressed air is supplied to the tank, and is arranged to discharge through several pipes at the bottom, thus thoroughly and economically agitating the slurry. The tank is made greater in height than in diameter, the proportions generally being about 2½ to 1, and has an inverted conical bottom.

There are two types of mechanical mixers in use at present; one is known as the "sun and planet" mixer, and the other is a mixer in which there are generally three vertical arms upon which suitable saddles are arranged. Both types are kept slowly revolving all the time.

Measuring Apparatus.—There are many types of measuring machines. The materials, either wet or dry, can be measured by weight or by volume, usually the former. Every type should be automatic in action, capable of being calibrated and adjusted while in action, and should be of the recording type.

Dry Materials.—If the materials are conveyed from the quarry by trucks, a weighbridge is employed which records the weight of each truck and its contents while the trucks are slowly passing over it. If the material is dry and is to be weighed when discharging from the bottom of hoppers, one form of measuring apparatus is employed where a conveyor band is arranged to run over rollers carried on a frame which acts as a weighbridge.

Wet Materials.—When measuring materials in a wet state in the form of slurry different apparatus is required. One apparatus consists of a series of buckets fastened to a rotating wheel; the buckets dip into a tank containing slurry at constant level and deliver a definite amount as they pass over the top centre into a chute. Another type of measuring apparatus consists of a wheel rotating in a vertical plane and provided with buckets fitted to the end of hollow arms. The buckets dip beneath the surface of the slurry, and, as they turn over the top, the material is projected down the hollow arms into a central chute.

Grinding Mills: Wet Process.—From the measuring apparatus the raw materials are mixed and fed into the grinding mill, water being added to the mixture at their entry into the mill. A "combination" mill is frequently the only type of mill that is employed to reduce the mixture from 1½in. sizes to a thick slurry. It is tubular in form, mounted at each end on trunnions and revolved at about 25 revolutions per minute. It is generally divided into three or four compartments by cast steel slotted diaphragms which permit the material to pass from one compartment to the next. The compartments are partially filled with balls or other grinding media, which are prevented from coming into direct contact with the shell by plates fitted all round the inner side. In some plants the hard materials are ground by a "ball" mill, followed by a "tube" mill, although it is now more usual to treat them in a "combination" mill, which is a combination of the two. The ball mill is the preliminary grinder and can deal with most materials from 2in. to 3in. in size and reduce them to 20-mesh size. When used in the dry process it is fitted with sieves, but in wet grinding the ground material, in the form of slurry, is discharged at the end remote from the feed end. The ball mill is partly filled with balls, the inside of the shell being protected with replaceable specially hard step-plates. A feed-table is generally used in conjunction with the ball mill. The relation of the diameter to the length of a ball mill is usually about five to three.

A tube mill consists of a horizontal rotary drum, about half full of balls or other grinding bodies of comparatively small diameter and of great hardness. The drum is supported on trunnion bearings, and rotates at a comparatively slow speed. The material enters through a hollow trunnion, moves through the whole length of the mill body while it rotates and is discharged at the opposite end of the mill in a pulverised condition. The tube mill is lined with special hard linings of various substances which have the property of resisting wear. The internal length of a tube mill is roughly four to five times its internal diameter, a usual size being about 31ft. 6in. in length and 6ft. 5in. in diameter, which would require about 250 horse-power. The output would depend on the amount of reduction of the material and its hardness.

The grinding mills used in the dry process are similar to those used in the wet process except for the provision of sieves. One type of ball mill is arranged with sieves over the whole area of the shell behind the wearing plates. In another type, the material has to travel along the length of the mill and pass out through a number of circular screens fastened to the outside of the shell, the particles too large for the mesh of the screen being returned to the feed end of the mill.

Separating.—After the slurry has been discharged from the final raw material preparation mill, it is passed through a separator which rejects all particles larger than the predetermined fineness. This fineness is such that the residue on a 180-mesh sieve does not exceed about 3 per cent. The separator is generally of the centrifugal type, with a vertical spindle. The slurry is fed into the centre at the top, and is forced by the centrifugal action through screens placed vertically around the perimeter of the machine. The particles too large to go through the screens are returned for further reduction. Alternatively, a secondary wash-mill, with fine screens of 0·5 mm. slots, is used.

When the mixed slurry leaves the separator, it is passed to correcting mixers. There are generally three of these, mechanically agitated. The usual procedure is to have at all times one in course of filling, one being corrected for percentage carbonate of lime, and one being discharged to the storage at the kilns.

Rotary Driers.—In the dry process the hard raw material and the soft raw material are crushed and rolled respectively, and fed to a storage hopper in a similar manner to the preliminary treatment of material being prepared by the wet process. After being discharged from the storage hoppers the materials are dried in a rotary drier and measured or weighed. Driers are of two types, direct-fired and waste-heat driers. The former consists of two long concentric steel-plate cylinders set with the delivery end slightly lower than the feed end, the gases from the drier furnace being taken down the central flue and then returned through the outer annular space, being finally discharged into the atmosphere by a fan. The material is fed into the outer annular space at the furnace end of the drier. Lifting flights are provided on the inside of the outer shell, and these raise the material to the top of the drier, thence dropping it on to the hot inner shell, where it is retained for the next half revolution by radial flights. The material in its wettest condition is therefore brought into intimate contact with the greatest source of heat. This operation is repeated over and over again, the material gradually working its way to the delivery end, due to the inclination at which the drier is set. The direct-fired drier has the great advantage that it can be placed anywhere, whereas the drier heated by waste gases from the kiln has to be arranged close to the gas exit of the kiln.

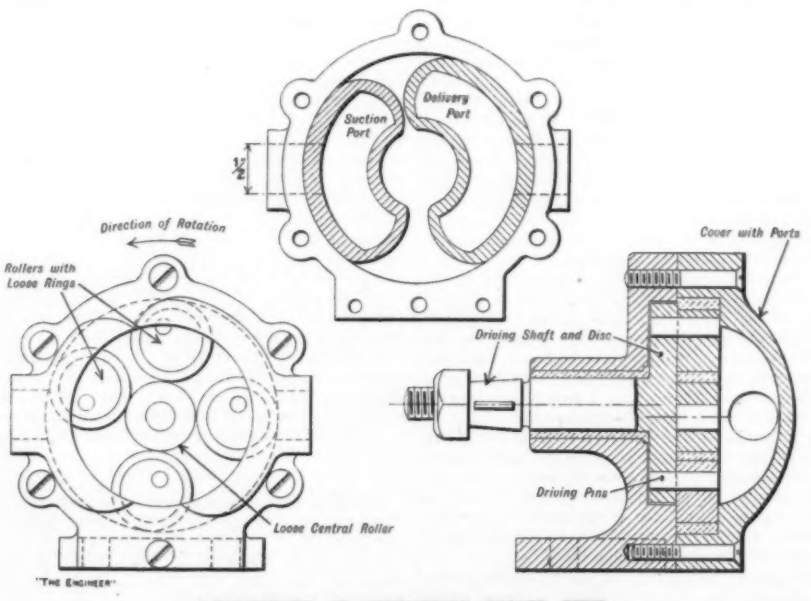
(To be continued.)

* The Institution of Mechanical Engineers. Abridged.

A Novel Roller Pump.

THE small rotary pump has been the subject of many ingenious inventions and patents, but the field for its improvement is as yet unexhausted. Within the last few days we have inspected a roller pump which is being manufactured for and introduced by Messrs. Malcolm and Feuerheerd, of 47, Victoria-street, London, S.W. 1, which firm owns the patent rights. The pump, which we are about to describe, was invented by Mr. E. Feuerheerd, who is already known as the inventor of another type of rotary pump.

The accompanying illustration serves to show the



ARRANGEMENT OF FEUERHEERD ROLLER PUMP

principle upon which the pump operates, and we may say that the particular pump which we examined had ¼in. connections and a designed capacity of 120 gallons of lubricating oil delivered per hour when running at a standard speed of 1000 revolutions per minute.

It will be seen that the body, which is made of cast iron, is integral with the base, and is bored out to take the driving shaft and disc. Attached to the body is the cover, which is secured in position by six screws, and, as shown in the upper part of our illustration, is furnished with suction and delivery ports. The exact position of these ports is fixed by a simple form of rotary slide rule, specially designed for the purpose. On the driving disc there are arranged four equidistant driving pins, each of which carries an excentic roller with a loose steel ring mounted on its circumference. When the pump is rotated in the direction indicated by the arrow, the four steel rings are trailed around the central loose roller, while at the same time they make contact with the inner wall of the pump cover, which is bored excentrically to the driving disc.

From our illustration it will be seen that the rollers when passing the suction port recede from one another, while when passing the delivery port they again approach each other. By this action liquid is sucked in and delivered against pressure. In course of the pumping operation the effect of centrifugal force on the rotating system keeps the roller rings tightly pressed against the pump casing, thus causing them to rotate and in turn to communicate their rotary movement to the loose central roller, which really only serves to separate the delivery and suction chambers. As all the working surfaces are both hardened and ground there is but little friction in the pump.

With the object of testing its performance a pump similar to the one we illustrate was run alongside a standard type of gear pump at the works of one of the leading Coventry motor manufacturers. The test figures which we have inspected give the results of a series of six intermediate speeds between 200 and 1000 revolutions per minute, four runs at a pressure of 10 lb., 40 lb., 60 lb. and 100 lb. per square inch having been made at each speed. During each separate run the time was taken for the two pumps to deliver ½ gallon of machine oil. At the lower speeds and at low pressures, the gear pump only delivered about half its designed capacity at the higher speeds, while running at a slow speed and delivering against a high pressure it only had about a quarter of its normal rated capacity. On the other hand, the new roller pump was shown to give a constant delivery with a remarkable exactitude throughout the whole of the series of tests which were run. That is to say, it delivered its designed output of 2 gallons per 1000 revolutions per minute at all speeds and at all pressures.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Depressing Conditions.

The Midland iron and steel market remains in a depressed condition, and the majority of those attending the Birmingham Exchange fail, they say, to perceive any evidence of an improved situation in the near future. Many of them indeed assert that business is going from bad to worse, and they have no hope of a real settling down to normal trading conditions before the new year. The last quarter of the year usually brings forth a fairly large volume of orders for the iron and steel works, but the autumn demand this year has failed to materialise. No one, even on last quarter day, anticipated such a dearth of orders as has prevailed so far this quarter. The staple industries of the Midlands and Staffordshire are employed in a more or less meagre fashion, and their requirements in the way of material are small. Engineering plants could do with considerably more business, and while the general volume is moderately good, there are few contracts of substantial dimensions being given out. Manufacturers of boilers, tanks, and the like find business only fair, but tanks for petrol storage for aviation purposes are providing more work. It is too late now, iron and steel masters assert, for any marked improvement in business this year. As things stand at present, there is little hope of stimulating demand in this market by further price concessions, and on the present volume of business many producers find it difficult to make ends meet. Many Midland industrialists on 'Change to-day expressed doubt as to their ability to keep plants operating, even on the present restricted level, for the remainder of the year.

Raw Iron.

Prices of Midland brands of pig iron are maintained, but there is very little being sold. It is indicative of the state of demand that with two more furnaces in operation and with one more working day the output of pig iron throughout the kingdom in October was only 5000 tons more than in the previous month. Most Derbyshire and Northamptonshire smelters have unplaced production for which they would be glad to find openings, but in a few cases furnacemen have sold their output to the end of the year. The prices at which business was done last week were quoted on 'Change in Birmingham to-day. Derbyshire No. 3 foundry was named £3 5s. 6d. to £3 6s.; forge, £2 19s.; Northamptonshire foundry, £3 0s. 6d. to £3 1s.; forge, £2 14s.; North Staffordshire foundry, £3 6s. Consumers of Cleveland iron have so far been unsuccessful in their attempts to be placed on an equal footing with foreign buyers, who are able to buy at 2s. 6d. less than the present quotation of £3 7s. 6d. for No. 3 g.m.b. Foundrymen continue to press for price concessions, but at the moment furnacemen are holding firmly to their quotations, claiming that to give way would merely make production less profitable and do little, if anything, towards stimulating demand. Founders continue to be good customers for high-class irons, but Midland foundries are missing very much the orders for light mill plant which usually come from the South Wales tin-plate trade. Heavy foundries are getting fair orders for large-sized rolls used in the steel mills. The pipe foundries have still a considerable amount of work in hand, though some of them have not been renewing their order books so satisfactorily of late.

Steel.

In the steel department there is great pressure for specifications. The orders arriving are for only small quantities, and hardly any tonnage is going on the books. Structural engineers report rather more inquiry, but the tonnages continue of a light character. For structural work native mills get preference over the foreigner owing to their ability to give quick and frequent supply. The rolling programmes of the various mills are comprehensive enough to cover every possible requirement. The demand for special steels is well maintained owing to the increased call for machine tools. Tube trade specifications, whether for English or foreign steel, continue very difficult to obtain, and the aggregate sales are poor. Various Midland industries are making use of cheap foreign material, and the sales make rather a large aggregate. The reorganisation of the Belgian Cartel has stiffened prices somewhat, but there are heavy sales of semi-finished material, and the large scale buying of local warehouses is a marked feature. Deliveries to two of these establishments are reported to have aggregated 1000 tons in one month. The price of foreign steel, when all rebate allowances are made, leaves a wide margin below British quotations.

Finished Iron.

There has been no development of note in the Staffordshire finished iron industry. Mills continue fairly employed in the best branches, but rollers of common bars are decidedly quiet. Prices remain as last week. The competition for the Crown bar business continues to result in pronounced differences in the quotations of various makers. Nut and bolt bars cannot compete in price with Belgian No. 3 iron, and the latter is being almost exclusively used in the Black Country nut and bolt and fencing works. Wrought iron gas tube strip is in moderate demand, users having to a great extent covered their immediate requirements. Supplies are available at £11 10s. per ton.

Sheet Prices.

The downward movement in galvanised sheets continues, £13 10s. now being the top figure, which can be shaded in the rare event of a good tonnage. Some mills have greatly lightened their reserve of orders during the past month. All the principal overseas markets are unresponsive, orders being small, even though sellers are willing to accept £13 7s. 6d. for 24-gauge f.o.b. There are mills understood to be off the market, however, as they consider present rates unremunerative. Black sheets are being sold in good quantities for the requirements of the motor industry, which continues extremely busy.

Tin-plates.

Efforts are being made to stabilise prices in the tin-plate trade at 18s. 6d. Birmingham for primes, and 18s. Birmingham for wasters. The export price for primes is 17s. 9d. Prior to this arrangement taking effect last week there was a certain amount of hurried buying, and this week business has been correspondingly quiet. Stocks are stated to be low, however, and will need to be renewed in the near future.

Honouring an Engineer.

The Midland Branch of the Institution of Mechanical Engineers held a complimentary dinner at the Queen's Hotel, Birmingham, on Monday last in honour of Sir Henry Fowler, chief mechanical engineer of the London, Midland and Scottish Railway, and President of the Institution. Mr. G. N. Guest, in submitting the toast of their guest, said Sir Henry Fowler was born in Evesham and attended Mason College in Birmingham. Sir Henry's record in engineering spheres was far famed. To him could be ascribed the success of that wonderful new locomotive, the Royal Scot. Sir Henry was responsible for much valuable engineering work during the Great War. In every way—as man, engineer, sportsman and President—they were delighted to do him honour. Sir Henry, in his reply, said that engineers should never forget Birmingham's association with James Watt, without whom George Stephenson would not have been of much value. Birmingham had produced some great engineers, who were esteemed throughout the world. Respecting the Institution, membership was becoming stricter, and would be more highly valued as the days went by. In responding to the toast of "The City and Industries of Birmingham," which had been proposed by Major S. J. Thompson (Wolverhampton), Sir David Brooks stated that trade competition and trade depression were prevalent, but he was not a pessimist; and his words would be to encourage all engaged in trade and business, even in engineering. There was considerable competition in machinery from Germany and the United States, but they should not allow their enterprise to fall behind that of those countries, and if they found they were not up to the standard of other countries, they should get over the difficulties and see that they altered their methods.

Newport and Midland Products.

That Newport (Mon.) ought to be an outlet for the exported produce of Birmingham and the Midlands, but is prevented from developing in that direction by "prohibitive" railway rates, was the contention put before the Railway Rates Tribunal in London this week, when Mr. Wrottesley applied, on behalf of the Newport Corporation and other local bodies, for a modification of railway rates. At Birmingham and in the Midlands there was being produced, he said, the very cargo which shippers required to enable them to operate economically, namely, such things as hardware, hollow-ware, enamel-ware, bedsteads, brushes, yellow metal, bicycles, motor car parts, wagon-work, and carriage-work. For the produce of the Midlands on its way to overseas markets no port could claim to lie more directly on the route than could Newport; but the fact was that practically none of that trade passed through Newport, and the reason, it was suggested, was that the railway rates were such as to prohibit it. Counsel quoted figures, according to which the charge for certain goods from Birmingham to Avonmouth was 18s. 4d., while for the same goods being carried to Newport, which was approximately the same distance, the charge would be 22s. 9d.

Probable Closure of B.S.A. Redditch Works.

It would appear that the rumours which have been current for the past week that the Redditch works of the B.S.A. Company are to be closed down and the plant removed to Small Heath, Birmingham, are well founded, for at a special meeting of the Redditch Urban District Council this week, a letter in reply to an appeal by the Council for a continuance of the works at Redditch was read, in which Sir Hallewell Rogers, chairman of the board of directors of the B.S.A., stated that there certainly was ground for the report. He pointed out that the present unsatisfactory state of trade conditions made it imperative that everything possible should be done to economise in cost of manufacture to enable them to maintain their business in the face of competition and the trade outlook. He assured the Council that no move would be made without every effort on the company's part to minimise the consequent hardship as much as possible, and the Council's appeal to the directors to reconsider the step would be discussed fully at a meeting of the Board to be held next week. I understand that about 1400 men and women will be affected if the decision to close the works and remove the plant to the company's Small Heath factories is carried into effect. A large number of these workpeople have been in the service of the Eadie Manufacturing Company and the B.S.A. Company for periods ranging up to thirty-five years.

Miners' Appeal.

The coal industry in the Cannock Chase and district coalfields is, in common with that in other mining areas throughout the country, feeling the effects of the falling off in the demand for coal which has been apparent since the mining stoppage of last year. Trade has never been in a worse state at this time of the year than at present. There are upwards of 4000 miners on the books of the Cannock Chase Employment Exchange, and the position is worst on the Hednesford and Heath Hayes side where the pits are only working half-time. So much real privation exists that an appeal to the general public of the Midlands for assistance to relieve the distress amongst miners and their families has been launched.

Unemployment.

This week I am able to record that the unemployment barometer has swung over from "cloudy" to "change." After two very substantial increases in the total of unemployed in the Midlands the latest returns record a decrease of over 3000. This but knocks off the edge of the 13,000 increase over the previous two weeks, but it is a movement in the right direction, and as such is welcomed. The total number on the live register is now 131,002. For the Birmingham area the total of 26,664 is an increase of 333 on the week. There was also an increase in Coventry, the figures advancing from 4756 to 5800.

LANCASHIRE.

(From our own Correspondents.)

Manchester.

Exports of Textile Machinery.

It is satisfactory to be able to record further heavy shipments of textile machinery last month, after the good results registered in the September returns, the total exports to all markets being well above the monthly average for this year. Shipments during the period under review were valued at £1,040,992, compared with £848,692 in October, 1926, and £1,021,938 in October, 1925. Of last month's total, exports of spinning and twisting machinery were responsible for £771,126, and of weaving machinery for £201,320, the respective tonnages being 7352 and 2674. Apart from the British East Indies, which were easily the most important individual market, the feature of last month's returns was the heavy shipments to European countries, and more particularly to Germany and the Netherlands. Exports to the British East Indies during the month were valued at £263,519, to Germany £120,777, to the Netherlands £84,441, to Russia £56,461, to South America £51,900, to Japan £42,754, to the United States £40,421, to Australia £39,407, to France £30,501, to China £27,052, and to "other countries in Europe," £219,661. During the ten completed months of this year the aggregate shipments amounted in value to £9,541,159, the quantity being 96,983 tons, of which £7,201,088 and 70,675 tons represented spinning and twisting machinery and £1,703,482 and 22,030 tons weaving machinery. Exports to the British East Indies during the ten months were valued at £1,899,364, to the Netherlands £820,233, to Germany £756,429, to South America £633,193, to Japan £612,147, to France £543,413, and to "other countries in Europe," £1,868,863. In spite of the marked falling off in shipments to Russia during recent months, exports to that country up to date amount in value to over £900,000.

Non-ferrous Metals.

A feature of the non-ferrous metals markets is the general improvement in all sections that has taken place since my last report, all the metals being dearer on balance than they were a week ago. In the case of tin, although the metal undoubtedly owes some at least of its improvement to a larger measure of speculative support than has been in evidence for some weeks, there has been a slight increase also in the demand for industrial purposes, and it is hoped that the new price agreement among tin-plate manufacturers in South Wales will before long be reflected in an improved consumption of the metal in that industry. Market opinion as to supplies is becoming

rather more "bullish" than it has been of late. Values at the time of writing in this section of the market are higher than since early in October. Contrary to the recently expressed view in some quarters that copper had about reached the limit of its advance for the time being, there has been continued firmness during the past week, and a further fairly substantial addition to market values. The world demand for the metal seems to be improving steadily. Domestic buyers are operating more freely, and in the United States and on the Continent, particularly in Germany, a steady call for copper is reported. Lead has shared in the improvement, although in this case the better tone seems to be due to an increase in speculative activity rather than to any expansion in the demand for industrial consumption, the latter remaining on somewhat quiet lines. With regard to spelter there has been less weak selling in evidence, and this fact, coupled with somewhat freer buying from industrial users, has had a strengthening influence on market values.

Iron.

It has again to be recorded of the Lancashire market for foundry iron that the current demand is extremely inactive, and that apart from inquiries here and there for relatively small quantities, buying interest has virtually ceased to exist for the time being. This, of course, is merely a continuation of the conditions that have been ruling here for about a month now, ever since, in fact, the autumn buying movement died away towards the end of October. In spite of the slow conditions so far as new business is concerned, Derbyshire makers are fully maintaining the slight advance upon the low prices of the year which they were able to enforce when users started to cover their contract requirements during the remaining months of the year. Delivery instructions against those contracts are being received by makers at a satisfactory rate, and stocks of pig iron at the blast-furnaces, at all events in the Midlands, are being kept at a low level. It has been stated here this week that in one or two instances producers are having some little difficulty in keeping abreast of specifications. Staffordshire brands of foundry iron are fairly steady at from 73s. to 73s. 9d. per ton, delivered Manchester or equal, with Derbyshire quoted at from 73s. 6d. to 74s. per ton, and Middlesbrough at 80s. 8d. per ton, also delivered. In the case of Scottish makes there has been some slight easing off latterly, and supplies have been obtainable on this market at down to 88s. per ton, although rather more than this figure is being asked by some makers. For hematite current quotations are at about 85s. 6d. per ton, including delivery into this area. Demand for manufactured iron is still restricted to small lots for comparatively early delivery, but there has been no change in the price situation, £10 per ton still being the Lancashire Association price for Crown bars and £9 10s. for seconds.

Steel.

The steel market in this area has received a slight fillip by the recent new business that has been placed with local constructional engineering firms, some of the orders being for fairly substantial quantities of material. Moreover, other important inquiries which are in circulation should add before long to the weight of business placed on the Lancashire market. Generally speaking, however, the demand for steel here remains relatively slow, and orders are being doled out sparingly, there being an almost entire absence of any important contract buying. Steel bars are still rather an easy section of the market, prices ranging from £7 10s. or £7 12s. 6d. for small re-rolled materials up to £8 10s., and buying is on a limited scale. A quiet trade is being done in boiler and general plates and in section materials, quotations for which are on about the same levels as a week ago, from £10 5s. to £10 10s. per ton being asked for boiler plates, £8 7s. 6d. for ship and tank plates, and £7 12s. 6d. for joists and sections. There is little buying interest at the moment in 24 gauge galvanised sheets, and export prices are weak at about £13 5s. per ton f.o.b., thin sheets also being in very slow demand at the lower range of prices now in operation. Continental steel makers are adhering to recent quotations for delivery of foreign materials into this area, although in view of the quiet demand and keen competition from merchants, they are having considerable difficulty in doing so.

Institution of Civil Engineers.

On Saturday last, the 19th inst., about thirty members of the Manchester and District Association of the Institution of Civil Engineers visited Lewis' large department stores in Manchester, following a descriptive paper read at the general meeting of the Association on Wednesday, the 16th inst., by Lieut.-Colonel W. S. Beaumont, M.C., F.R.I.B.A. The visitors were received by the chief engineer, Mr. Noble, and were much interested in the engineering features of the establishment, amongst which were the arrangements for ventilating, heating and lighting, cooking, vacuum cleaning, conveyance of customers by escalators and lifts, and of merchandise by belts and chutes. The cash tube system is one of the largest in the world. After the inspection, the party made a similar tour of the Withy-grove establishment of Allied Newspapers, Ltd., where it was guided through the various departments for the dissemination of news collected from all over the world, including the telegraph and telephone receiving rooms, the editorial section, the composing floor, the Linotype machines, the Autoplate casting machines, the printing presses working at 800ft. per minute, the publishing department that is responsible for the dispatch to all parts of the country and abroad of the parcels of papers, &c. After the tour of inspection, the visitors were invited to have tea in the staff dining-room, where the chairman of the Association, Mr. Daniel Adamson, M. Inst. C.E., suitably acknowledged the obligation under which the members felt themselves to the directors of Allied Newspapers, Ltd.

BARROW-IN-FURNESS.

Hematite.

The flatness in the hematite pig iron market in this district continues. The trade generally is suffering from quietness to a certain extent, and also from the fact that buyers are very keen at present. It may be that competition both from abroad and from the East Coast is having its effect upon the local demand. Three furnaces have been put out at Cleator Moor and one at Ulverston, and in both cases the cause is the accumulation of stocks and a falling away in tonnage as regards orders. On the other hand, at Millom another furnace has been put in blast, which is rather remarkable. Millom's extra output is due to certain orders for special qualities, but it certainly shows that this company is fully alive to the possibilities of the market, and has brought down its production costs to the lowest. There is a certain amount of American trade possible, but the price offered is not tempting in most cases. Small parcels are going coastwise, but do not amount to much. The iron ore trade, in consequence of four furnaces having gone out, is naturally seriously affected, and only one mine is now at work in Cumberland. This is the Florence Pit, which is owned by the Millom Company. The steel trade continues in moderate activity, and Barrow has orders which will keep the works going for some time. Since the Barrow Steel Works restarted, there have been no stoppages whatever, except for holidays. At Workington the mines are again engaged, but it is feared that, unless fresh orders are received, they cannot continue to run long. The hoop department at Barrow is well booked ahead.

SHEFFIELD.

(From our own Correspondent.)

Conditions in the Steel Trades.

THE state of the basic steel industry continues very unsatisfactory, not only in the immediate district of Sheffield, but also in North Lincolnshire, where the depression is growing serious. Production is on a low scale, and although there have been no further reductions lately, new business is so scarce that the continuance of work on the present level is by no means certain. Easier prices prevail in the iron and steel markets generally, and the buying of raw materials is for the most part restricted to the requirements of the moment. Last week the North Lincolnshire Iron Company commenced to blow out one of two furnaces that have been in blast since the works were restarted, this making the third blast-furnace in the Scunthrope district to be put out of blast during the past few weeks, owing to the bad state of trade. On the manufacturing and lighter sides of the steel trade a better state of things obtains, and, while it cannot be said that much progress is being made towards a real revival, there is a general feeling that the New Year should see an improvement. Many orders come forward, but for the most part they are small, and large contracts, which would ensure work ahead, are wanting. Better reports continue to come to hand with regard to railway work, and prospects are considered encouraging. The growing activity at the shipyards is also a hopeful sign, as it foreshadows an increased call for Sheffield steel and tools. The wagon builders are short of work, but it is stated that local firms are to share in the construction of a number of 20-ton steel coal wagons which Welsh collieries are ordering for service on the Great Western Railway.

Another Capital Reduction.

Henry Bessemer and Co., Ltd., manufacturers of railway material, Sheffield, propose to follow the example which Vickers Ltd. set two years ago and reduce the nominal value of their ordinary shares from £1 to 6s. 8d. each. The directors, in a letter to the shareholders, point out that, owing to accumulated trading losses suffered during recent years, the debit balance to profit and loss account at the end of last year was £64,286. The proposed reduction in the ordinary shares will provide £155,667, which, together with £5287 proposed to be provided from reserve, will suffice to wipe out the debit to profit and loss account, and also to reduce the book value of the company's works from its present figure of £267,048 to £171,128, which the directors consider to be a fair value to place upon them under present-day conditions. The directors remark that the writing down of the value of the works to a conservative figure will not only justify the division of a larger proportion of any trading profits earned by the company in the future than could be justified were the works still over-valued in the balance sheet, but it will curtail the interval which must elapse before a dividend is paid. With regard to the current year, the directors anticipate a trading profit.

A New Railway Bridge.

The London, Midland and Scottish Railway Company is erecting a new steel bridge over the Dearne and Dove Canal near Swinton Station, to supplant an old brick-arch bridge, for carrying its main line between Sheffield and Leeds. The bridge is of mild steel built-up girders and floor plating, and has been constructed by Markham and Co., Ltd., of Broad Oaks Works, Chesterfield. The first portion, consisting of eight girders, has been placed in position under the supervision of the railway company's officials. The girders, which weighed 48 tons, were laid with the aid of a railway company's 36-ton crane, the work occupying two and a half hours. The second and final portion will be erected during the next few weeks.

University Equipment.

The heat engine equipment of the University of Sheffield has been increased by the installation of a new oil engine in the Applied Science Department. The engine, which has been made by Ruston and Hornsby, Ltd., is of the modern solid injection type, and uses heavy oils, the fuel at present in use having a specific gravity of 0·92. The engine develops 25 H.P. at a speed of 295 revolutions per minute. It is started by compressed air from a cylinder charged while the engine is running. The indicated and brake horse-power can be determined, and special arrangements have been made to determine the oil consumption. There are also special air inlet arrangements, and apparatus is being installed so that the quantity of air admitted can be definitely measured. The amount of heat carried away in the jacket water and in the exhaust gases can also be measured, and special pockets have been arranged on the exhaust pipes so that samples of exhaust gas and temperatures can be taken.

Colliery Progress.

The Houghton Main Colliery Company, near Barnsley, is carrying out developments in the Parkgate seam by sinking a new shaft, which has already reached a depth of 400 yards. The seam is at present being worked from a shaft sunk from the Barnsley bed, but it is expected that when the new shaft is completed the workings of the Parkgate will be extended, and employment found for a large number of additional men.

Motor Sets for Tramways.

The Tramways Department of the Sheffield City Council has ordered 100 motors with gears from the Metropolitan-Vickers Company, Ltd. It is understood that the sets will be built at the company's Sheffield works; 110 sets of a similar character were supplied by the same firm to the Corporation last year.

Cutlery and Plate.

The cutlery and plate trades have enjoyed an exceptionally active Christmas season, and their output largely exceeds that of last year. Most of the special ordering for the season has now ceased, and pressure is easing off. While, however, there are some complaints of quietude, a good many firms engaged on best quality plate are still busy, and some of them are having to work overtime. Owing to the falling off of work in the building trade, the demand for stove grates and rain water castings has declined, and the local foundries which specialise in these products are mostly on short time.

NORTH OF ENGLAND.

(From our own Correspondent.)

Durham Coal Settlement.

THE acceptance by the Durham miners by a substantial majority of the proposals of the coalowners provided welcome news in Northern coal trade circles, and there is now reasonable ground for hoping that in due course the difficulties of the situation will be composed, and with distinct gain to the industry. At all events the majority in favour of acceptance was so substantial as to eliminate the prospect of that trouble in the coalfields which was forecast recently by the more extreme section of the men, and it will certainly tend to restore confidence in the market. The owners' proposals involved the inclusion of the Northumberland arbitration clause in the Durham County agreement. By the acceptance of the terms, the owners will defer revision of the minimum rates until January 15th, 1928, and the decision of the Board or its chairman will take effect as from March 1st, 1928. The same applies to the subsistence wage.

The Shipbuilding Industry.

The Northumberland Shipbuilding Company (1927), Ltd., Howden-on-Tyne, has been successful in booking further important contracts for new vessels. Cardiff owners have ordered a cargo vessel of 9000 tons deadweight carrying capacity, while London owners have placed an order with the Howden firm for two even larger vessels. The North-Eastern Marine Engineering Company, Ltd., Wallsend, will supply the engines for the Cardiff steamer and Wallsend Slipway and Engineering Company, Ltd., the engines for the other two vessels. The position in the shipbuilding industry on the North-East Coast, however, is not so encouraging as it was six months ago. Some yards certainly have a substantial amount of work in hand, but it has to be realised that there are still a large number of vacant berths, and there is no immediate prospect of the half-dozen yards at present closed down being restarted. Output is so rapid that the new orders fall far short of what is required to maintain a continuity of work, and it is that factor which is causing anxiety amongst shipbuilders.

Big Steel Contract.

An order for 25,000 tons of structural steel has been placed by the Synthetic Ammonia and Nitrates, Ltd., of Billingham-on-Tees, with Dorman, Long and Co., Ltd., Middlesbrough. It is one of the largest contracts of its kind ever placed in the Tees-side district, and will help materially to keep Messrs. Dorman Long's structural department working during the winter months. Synthetic Ammonia and Nitrates, Ltd., is a branch of the Imperial Chemical combine, and the steel is to be used in the developments which are at present taking place at Billingham-on-Tees.

Cleveland Iron Trade.

The quietness now ruling in the Cleveland pig iron trade has not removed the feeling of confidence in the future. Consumers' present disinclination to negotiate for supplies is regarded as only what might have been expected after the recent period of market activity. Many contracts covering requirements over the next few months have been arranged, and buyers are not disposed to enter into further commitments just now. An early resumption of market operations on a moderate scale would not, however, cause any surprise. Reports from iron centres on the Continent encourage hope of transactions here. Many firms abroad are understood to be fairly well sold, and are stated to be less keen in competing in the Cleveland market. Values of Cleveland pig iron are well maintained, and makers are in a strong position. Their stocks have been reduced to small dimensions and their output still fails fully to satisfy current requirements, with the result that the now small accumulations at the works continue to dwindle. Most of the iron is going into local consump-

tion, but home users at a distance are taking rather larger supplies. There are now forty-one blast-furnaces in operation on the North-East Coast, Bolckow, Vaughan and Co., Ltd., having restarted the furnace put out of operation recently owing to an accident. The f.o.b. quotations for sales to customers beyond the Tweed and abroad are 2s. 6d. below the following rates for home consumption :—No. 1 Cleveland foundry iron, 70s.; No. 3 G.M.B., 67s. 6d.; No. 4 foundry, 66s. 6d. ; and No. 4 forge, 66s.

Hematite Pig Iron.

There is a rather steadier feeling in the East Coast hematite pig iron trade, but with output slightly in excess of demand, and producers anxious to book orders, quotations continue to vary somewhat. A feature of the trade is the demand from Germany, sales to that country having been doubled as compared with previous months. Most of this business is in high silicious qualities. Mixed numbers are in the neighbourhood of 71s. 6d. for home purposes and for dispatch to foreign destinations.

Ironmaking Materials.

Though there is little business being done, sellers of foreign ore are inclined to take a firmer stand. Best Rubio ore remains at 21s. per ton c.i.f. Tees. Makers of Durham blast-furnace coke have been compelled to lower their quotations, but the reduction has failed to tempt consumers to negotiate for anything like extensive supplies. Good medium qualities are 17s. 6d. to 17s. 9d. per ton delivered at the works.

Manufactured Iron and Steel.

In the manufactured iron and steel trade, prices are, without exception, unchanged. A steady volume of output is maintained in several products, and with some potential buyers standing off the market, the prospects of continued activity are favourable. Orders are expected to come forward more freely in the New Year.

The Coal Trade.

The recent gales have caused a great deal of dislocation in the Northern coal trade. Pits that had a good carry-over of tonnage for this week have been able to carry through shipments, but others dependent on tonnage arrivals have been hard pressed to get prompt clearance of wagons, and in many instances spot coals have been obtainable at discounts, where buyers could take immediate delivery. Forward the tone is firmer for many grades, especially best steams, as any delays in spot shipments will have to be made good as soon as tonnage arrives. If the demand keeps up, as it may do in view of the near approach of Christmas, values are likely to be well upheld to the end of the year. Best Northumberland steam coal producers are the most favourably circumstanced at present so far as demand is concerned, and hold firmly to recent prices. Best qualities command 13s. 6d. to 14s., and seconds 13s. There is also sufficient demand for steam smalls to clear off output, and other classes of Northumberland fuel are in fair request. First and special grades of Durham gas fuel are tending stronger at from 15s. 6d. to 16s. 3d., and second qualites are rather better placed at late figures. Coking coals have become dull again, and bunkers are in best demand for the higher classes. The coke trade is unchanged. The demand is good for gas coke, but with very limited supplies offers of 24s. 6d. to 25s. fail to attract sellers. Prices are absolutely nominal, as there are practically no sellers. Patent oven cokes are quiet and in ample supply, good makes at 17s. to 18s., special makes 23s. to 25s., and beehive coke 25s. to 30s.

SCOTLAND.

(From our own Correspondent.)

Little Fresh Movement.

The steel, iron, and coal markets show little change from the conditions prevailing during the past months, which, apart from occasional spurts here and there, have been, to say the least of it, drab. Business on the whole, is irregular, and prices unsteady, and the outlook, both in home trade and in export, holds no sign of improvement generally.

Steel.

Recent reports from the Lanarkshire district indicated a bleak lookout for the winter months, and there were rumours of works closing down indefinitely. Happily, however, the position has changed, and though activities may not be up to normal, enough business has been placed, chiefly for railway material, to enable the works to carry on for some time on a partial basis at least. New orders for heavy steel are very limited, but makers are more hopeful in view of the upward trend of continental prices.

Steel Sheets.

Steel sheet makers are comparatively quiet. Heavy sheets are in only a very moderate demand, the bulk of the business passing being for the lighter gauges. Prices are fairly steady.

Iron.

Continued quietness amongst consumers of bar iron keeps the market in a state of inactivity, and even the addition of orders for re-rolled steel bars fails to maintain a regular rate of employment. The home price of each material is fixed, but considerable concessions can be secured when a good export order is in prospect. Bar iron for export is quoted £10 5s. per ton, while re-rolled steel bars are £7 15s. per ton home and about £7 2s. 6d. for export.

Pig Iron.

In an unsatisfactory trade the pig iron section is probably the worst feature. Outputs have been reduced, but in face of low competitive prices stocks continue to accumulate, and even when makers are prepared to make concessions, business is difficult to secure, and when obtained, is usually small in quantity. A continuance of present conditions must inevitably result in a further curtailment of output, which at present only reaches about 25 per cent. of the normal pre-war rate.

Exports and Imports.

The quantity of iron ore discharged during last week was the smallest recorded for some considerable time, and amounted in all to 300 tons. Within the same period 2300 tons of steel and iron arrived from the Continent and some 500 tons of pig iron from India. Shipments of iron, amounting to 1700 tons, were dispatched to Canada, South Africa, Germany, Spain, Peru, and Chile. Moderate quantities of tubes and structural material were also exported.

Coal.

The recent activity in the export department has dropped off, and most fuels are again in need of fresh orders, with a consequent easing in prices. The activity alluded to was the direct result of a covering sale by exporters and was not fresh business. During the period collieries increased their prices for export, which has had the effect of bringing business practically to a standstill. Lanarkshire best splints are an exception. This fuel is fully booked until the end of the month at least, and only small quantities are available. Lanarkshire steams and ells, Fifeshire and Lothian steams, and washed nuts in all districts, especially the last mentioned, are weaker in price. Aggregate shipments amounted to 259,997 tons, against 246,917 tons in the preceding week and 255,141 tons in the same week in 1925. The general demand on home account is far below normal for this season of the year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

It cannot be said that the conditions in the steam coal trade have improved during the past week. No doubt the position of some individual concerns is better, but taken on the whole there is scarcely any change. Certainly prices have not undergone any material change, except that perhaps small coals are rather weaker. One hesitates to say that the worst has been reached, and that the conditions must therefore improve, for the reason that most people in the export trade have been saying that for many months past, and still the market has continued to show a drooping tendency and business has become quieter. Still there is a limit and the future is not without hope, though it is useless to be blind to the fact that trade will be very difficult for some time. Shipments from this district for the week ending the 18th inst. amounted to just over 435,000 tons, which was an improvement of over 24,000 tons upon the figures for the preceding week; but, as previously pointed out, it is necessary for shipments to run to more like half a million tons per week to impart any steadiness to the market. Chartering has lately been rather less active, yet at the same time the collieries have been better placed for tonnage, owing to the arrival of steamers which had been delayed by bad weather. Idle loading appliances at the various docks at the end of last week numbered thirty-nine, but as the result of arrivals of tonnage over the week-end, Monday opened with there being twenty-seven tipping appliances at a standstill. Most people are looking for some improvement from now to the end of the year, and it is quite possible that some buyers abroad may be disposed to come along for supplies for the reason that quite apart from the prices of coal there is the important factor relating to freight rates. These rates are now down to as low a level as can reasonably be expected, and it would not require very much fresh business to come on the market to bring about a recovery in values, especially for large-sized steams. Buyers know this quite as well as sellers on this market. As regards business over next year, hopes are entertained that South Wales will recover some of the orders which were lost owing to the national strike of last year. There is no doubt that as a consequence of that disastrous struggle many consumers abroad contracted for continental coals for delivery over the whole of this year, but with their termination in about a month's time South Wales should stand a good chance of getting some of the business back again. Mention has been made of the fact that a certain amount of business has been done in best Admiralty large coals over 1928 at round about 19s. f.o.b. Since then the Cie Generale Trans-atlantique is credited with having bought part, at any rate, of its next year's requirements at 18s. 9d. to 19s., and it is announced that the Egyptian State Railways are prepared to contract for 200,000 metric tons, instead of 150,000 metric tons, of large coals for delivery over the first four months of next year. Tenders have to be in on December 1st. News is awaited regarding the Algerian State Railways' business, while other inquiries about concern the French State Railways and the Paris-Orleans Railway. So far, the large middlemen firms on this side have not entered into contracts for supplies over 1928. Their position is undoubtedly a difficult one, and one of the hindrances to fixing up contracts undoubtedly relates to the heavy arrears on the current year's contracts.

Stabilisation of Prices.

Since writing last week there has been one very important development, inasmuch as an official announcement of a preliminary character has been made relative to the scheme proposed by the coalowners for stabilising the coal market. There was a meeting of the South Wales Coalowners' Association at Cardiff on Thursday last, when the whole matter was given full discussion, and it was decided to form a separate association, to be called "The South Wales Coal Marketing Association," to carry out the objects of the scheme, and a Committee, of which Mr. F. T. Halford was elected chairman, was appointed to settle the details. According to Mr. Finlay Gibson, the secretary, the first principle of the scheme provided for a contribution from the colliery companies of 3d. per ton on their output to a "pool" which would be available for compensating companies, the colliery or collieries of which lost shifts through want of trade owing to their not accepting prices below the economic value. In the second place, the scheme laid down that the collieries in the coalfield should be divided into groups according to the description and grading of the coals produced from the respective collieries, and that a committee for each group should take steps as might be necessary to stabilise prices. There is to be no restriction or allocation of output, the whole object of the scheme being to get the best prices possible for South Wales coals, and at the same time reduce the cost of production by more regular working, and, if possible, increase the volume of the export trade. It is understood that it is the intention of the coalowners to bring the scheme into operation with the least possible delay, and its introduction is awaited with the greatest interest by all concerned in the export trade, and more especially the details regarding the prices which are fixed for the various grades. Many are withholding judgment pending the details, though a good deal of acepticism prevails as to its success. It is understood that coalowners in other districts are watching the action of South Wales very closely, and that they may very possibly follow the lead given to them. As a matter of fact, exporters would have more faith in the success of such a scheme if it applied to all the coalfields of this country instead of operating in this district only.

Spain and Coal.

The export of coals to Spain has undoubtedly suffered of late through the restrictions which have been imposed by the Spanish Government and the institution of the system of licences. The Spanish Government intended also to set up a centralised coal-buying commission as well as a selling department in Cardiff, through which all coal required from South Wales would have to be bought and shipped. Naturally, exporters became very anxious at these possible developments, and strong representations were made, with the result that at the end of last week the announcement was made that consequent upon the negotiations which had taken place between the British Ambassador in Spain and the Spanish Government, it had been declared to the former that it was not the intention now or in the future to introduce a monopoly for coal in Spain. Hopes are entertained that before very long the Spanish Government will go a step further and withdraw all restrictions, as it is felt that it would be in the interests of all concerned for trade to proceed unfettered.

Tin-plate Pooling Scheme.

Tin-plate manufacturers met at Swansea on Tuesday to consider the position regarding the pooling of orders. A week ago the minimum price of 17s. 9d. was decided upon, since which time the market has gained strength. The proceedings at the meeting on Tuesday were private, but it is understood that agreement was come to that the minimum price of 17s. 9d. should be continued, and as regards the question of limiting output, the proposal is that works may stop any three weeks out of thirteen.

Swansea and Super Electricity Station.

Alderman Morgan E. Rees, vice-chairman of the Swansea Electricity Committee, speaking at the end of last week, referred to the possibilities of a super electricity station at Swansea costing about 2½ million pounds, and providing employment for 2000 to 3000 men. He said that the Swansea district had been marked out for one of the new super-stations which would shortly be supplying electrical energy throughout the country. The Corporation now supplied power in the Swansea and Amman valleys, and for that reason the Committee felt it was in a very strong position. The time was coming when the matter would have to be decided. The first unit of the new station would cost somewhere about half a million of money, and in another few years about two millions of money would be spent. Some 600 men would at first be employed, and later more would be necessary. Some thousands of tons of coal would be needed, and that could be raised in the borough.

Current Business.

The trouble at the moment is that the current demand for coals of all descriptions is on a very limited scale. Many collieries have found it very difficult to carry on, and temporary stoppages have continued to be numerous. Coalowners have resisted as far as possible the acceptance of lower prices. Large coals have not shown much alteration, though best Admiralty large do not command more than 19s. to 19s. 6d., and other qualities display some irregularity. Small coals have been in a more plentiful supply, whereas the demand has not been so keen, with the result that values have given way, and best descriptions are now round about 12s. 6d. Coke and patent fuel meet with a very moderate inquiry, while pitwood buying is somewhat restricted, this commodity being now about 27s. 6d. to 27s. 9d.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Spencer-Bonecourt, Ltd., asks us to announce that it has changed the address of its offices from Parliament Mansions, Victoria-street, S.W. 1, to Broadway Buildings, Broadway, S.W. 1. Telephone, Victoria 2802–3.

The B.E.N. Patents, Ltd., of 92, Tottenham Court-road, London, W. 1, asks us to announce that it has been appointed by the U.S. Electric Tool Company as sole concessionnaire for the British Isles for that company's portable electric tools.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	21/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 16 0	—
No. 1 Foundry	3 17 6	—
No. 3 Foundry	3 12 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 11 6	3 11 6
No. 1	3 12 0	3 12 6
Cleveland—		
No. 1	3 10 0	3 7 6
Silicious Iron	3 10 0	3 7 6
No. 3 G.M.B.	3 7 6	3 5 0
No. 4 Foundry	3 6 6	3 4 0
No. 4 Forge	3 6 0	3 3 6
Mottled	3 5 6	3 3 0
White	3 5 6	3 3 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	3 6 0	—
(3) Northampton—		
Foundry No. 3	3 0 6 to 3 1 0	
Forge	2 14 0	—
(3) Derbyshire—		
No. 3 Foundry	3 5 6 to 3 6 0	
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0 to 3 5 0	
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 6 6 (*a*); 4 9 6 (*b*); 4 13 0 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export £ s. d.
Scotland—		
Crown Bars	10 15 0	10 5 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 15 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	12 10 0	—
S. Yorks.—		
Crown Bars	11 0 0	—
Best Bars	12 5 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 12 6 to 10 0 0	
Marked Bars (Staffs.)	13 0 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	
Gas Tube Strip	11 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	8 15 0 to 8 17 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	14 5 0	£13 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	
Billets	7 10 0 to 10 0 0	
Manchester—		
Bars (Round)	8 10 0	—
„ (Small Round)	7 12 6	—
Hoops (Baling)	10 5 0	10 0 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
„ (Lancs. Boiler)	10 10 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	
Intermediate Basic	7 10 0	—
Soft Basic	6 10 0	—
Hoops	10 0 0 to 10 10 0	
Soft Wire Rods	9 5 0	—
Midlands—		
Small Rolled Bars	7 12 6 to 8 0 0	
Billets and Sheet Bars	6 5 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	13 7 6 to 14 0 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	17/9 to 18/–
Block Tin (cash)	267 0 0
„ (three months)	264 0 0
Copper (cash)	59 12 6
„ (three months)	59 15 0
Spanish Lead (cash)	21 7 6
„ (three months)	21 15 0
Spelter (cash)	26 12 6
„ (three months)	26 6 3
Manchester—	
Copper, Best Selected Ingots	65 2 6
„ Electrolytic	65 5 0
„ Strong Sheets	88 0 0
„ Tubes (Basis Price), lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
„ Condenser, lb.	0 1 1½
Lead, English	22 15 0
„ Foreign	21 15 0
Spelter	26 15 0
Aluminium (per ton)	£107

FERRO ALLOYS.

Tungsten Metal Powder	1/8 per lb.
Ferro Tungsten	1/3 per lb.

	Per Ton	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 17 6	7/3
„ „ 8 p.c. to 10 p.c. „	£22 10 0	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 0 0	11/6
„ „ „ 1 p.c. carbon	£41 10 0	15/–
„ „ „ 0·70 p.c. carbon	£53 0 0	17/6
„ „ „ carbon free	1/4 per lb.	
Metallic Chromium	3/– per lb.	
Ferro Manganese (per ton)	£12 0 0 for home; £16 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/– per unit	
„ „ 75 p.c.	£20 5 0 scale 6/– per unit	
„ Vanadium	14/3 per lb.	
„ Molybdenum	5/– per lb.	
„ Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/3
„ „ Ell	13/9
„ „ Splint	15/6 to 17/6
„ „ Trebles	14/6
„ „ Doubles	13/6
„ „ Singles	10/6 to 10/9
Ayrshire—	
(f.o.b. Ports)—Steam	13/3
„ „ Jewel	15/6
„ „ Trebles	14/9
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/9 to 12/6
Screened Navigation	18/–
Trebles	14/3 to 16/6
Doubles	13/6 to 13/9
Singles	10/9 to 11/–
Lothians—	
(f.o.b. Leith)—Best Steam	12/9
Secondary Steam	12/– to 12/3
Trebles	14/6
Doubles	13/6
Singles	10/9

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	24/– to 25/–
Household	40/– to 56/–
Coke	22/6 to 23/6
Northumberland—	
Best Steams	13/6 to 14/–
Second Steams	12/9 to 13/–
Steam Smalls	9/– to 10/–
Unscreened	13/– to 13/6
Household	21/– to 27/–
Durham—	
Best Gas	15/6 to 16/–
Second	13/3 to 14/–
Household	21/– to 27/–
Foundry Cok	19/– to 26/–
Sheffield—	
Best Hand-picked Branch	28/– to 30/6 —
Derbyshire Best Bright House	23/– to 24/– —
Best House Coal	22/6 to 23/– —
Screened House Coal	19/– to 20/– —
„ „ Nuts	16/– to 17/6 —
Yorkshire Hards	14/6 to 16/6 —
Derbyshire Hards	15/– to 17/– —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/– to 7/– —
Smalls	3/– to 4/6 —
Blast-furnace Coke (Inland)	13/– at ovens —
Furnace and Foundry Coke (Export), f.o.b.	18/– to 18/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/– to 19/6
Second Smokeless Large	18/6 to 19/–
Best Dry Large	18/3 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	17/9 to 18/–
Western Valley Large	17/6 to 17/9
Best Eastern Valley Large	17/– to 17/6
Ordinary Eastern Valley Large	16/9 to 17/–
Best Steam Smalls	12/6 to 12/9
Ordinary Smalls	11/– to 12/6
Washed Nuts	18/– to 20/6
No. 3 Rhondda Large	19/6 to 20/–
„ „ Smalls	15/6 to 16/–
No. 2 „ Large	16/– to 16/6
„ „ Through	14/6 to 15/6
„ „ Smalls	13/– to 13/6
Foundry Coke (export)	30/– to 37/6
Furnace Coke (export)	27/6 to 30/–
Patent Fuel	22/6 to 24/–
Pitwood (ex ship)	27/– to 27/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	32/6 to 35/–
Seconds	27/6 to 30/–
Red Vein	20/6 to 26/–
Machine-made Cobbles	36/6 to 40/6
Nuts	38/6 to 42/6
Beans	23/6 to 28/6
Peas	17/– to 19/–
Breaker Duff	8/6 to 9/–
Rubbly Culm	7/9 to 8/–
Steam Coals:	
Large	18/– to 19/–
Seconds	16/– to 17/–
Smalls	10/3 to 11/3
Cargo Through	15/– to 16/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate 7/6 joists and 5/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

The Industrial Situation.

WHILE some constructive engineering firms have a fair number of orders in hand, the majority of them find it difficult to keep their shops running at all, and it is this irregularity in the distribution of work which gives an undecided character to the situation, some declaring that there is a little more activity and others affirming that matters are going from bad to worse. So long as there is no revival of public and private enterprise there can be no recovery, and for the moment the orders distributed are restricted solely to those necessitated by the carrying out of works, the money for which is provided largely by the State and the Colonial Administrations. The requirements for naval construction are fairly heavy, while the equipment of goods trains with continuous brakes will provide employment for a considerable number of makers, mainly in the Ardennes, and as the Government of Equatorial Africa intends to issue another loan for the execution of public works, including the construction of the railway from Brazzaville to the coast, it is certain that that work will be of considerable benefit to makers of railway and other material. The Government has also in hand a programme for building construction in and around Paris which should absorb a large quantity of material during the next five years. If the financial situation should improve sufficiently to permit of the carrying out of the public works at present in abeyance there is obviously hope for the future. Many are being executed with the aid of German material supplied on account of reparations, and although that means so much less to be provided by French makers, the latter, nevertheless, benefit from the supplementary work which would not be given out if there were no German reparations to allow of public works being put in hand. Nevertheless, the structural engineering works are absorbing far less iron and steel than they did a year ago, and although there is an occasional spasmodic demand which raises hope of an improvement, the situation of mill and forge owners continues to be precarious. As German requirements exceed the quota of steel production in that country, there is an increasing importation of rolled steel which is apparently worked up for export. So far as France is concerned the situation may be judged from the fact that the railway deficit during the present year is estimated to be something like 1000 million francs, mainly through the decline of goods traffic, and it is believed that this will inevitably result in another reform of the railway administration.

Paris Transport.

Notwithstanding the improvements that have been carried out in the Paris traffic arrangements, notably in the adoption of the one-way system, the number of vehicles is increasing so rapidly that a solution of the problem appears to be hopeless, unless it be possible to carry out some of the proposals for diverting traffic underground. Not only is Paris itself congested, but the suburbs are rapidly extending, and are far outstripping the existing transport facilities. It is therefore recognised that some urgent solution is required, and Monsieur Mariage, who has been identified from the beginning with the motor omnibus and mechanical transport services generally in Paris, proposes a system which he believes will overcome the difficulty. His idea is to utilise the existing main lines radiating from Paris for the running of a fast service of trains to the limit of the agglomeration. A number of transversal lines would be connected up with each main line, which, he explains, would have the appearance of a herring bone. The present Metropolitan Railway, which is the most efficient form of urban traffic possible, would be extended to the limit of the transversal lines, so that there would be a complete network of railways which would bring passengers rapidly from any part of the outlying suburbs to the centre of Paris.

Domestic Heating.

As the result of the visit of a delegation from the Municipal Council of Paris several months ago to Hamburg, where there is a distribution of steam for domestic heating, in the same way as is done in some other German towns as well as in the United States, a plan was prepared for a similar distribution in Paris. At a recent meeting of the Council it appeared that the idea was taking definite form, and that before long negotiations will be carried out for the distribution of steam over a radius of three miles from the generating stations. It is claimed that apart from the convenience of the system for householders, it has the further advantage of suppressing smoke and of economising coal consumption. It is proposed to start by utilising the old Metropolitan power station on the Quai de la Rapée, which has long been abandoned, for heating the eastern quarters of Paris. Householders will pay for heat units as measured by the quantity of condensed water.

Port of Cherbourg.

The traffic of Cherbourg has increased so considerably of late years that about 200,000 passengers now land and embark annually. Practically all the Transatlantic vessels call at Cherbourg, and most of them have to remain outside the harbour while the passengers are conveyed to and fro in boats. This is to be avoided by the carrying out of vast works, the cost of which will be not less than 28,600,000 francs. It will be done mainly with the aid of German reparations. The biggest undertaking will be the construction of a mole which will provide an area of 25 acres for the maritime station, while an extensive system of dredging and the construction of piers will permit of ships drawing 11 m. of water to enter at all tides, while those drawing 14 m. will be able to come up alongside the piers from half tide. The maritime station will, it is claimed, be one of the largest in the world. The mechanical equipment of the port will be carried out on the most modern lines. Special provision will also be made for seaplane traffic, which, it is hoped, will be largely centralised in the port of Cherbourg in the future.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

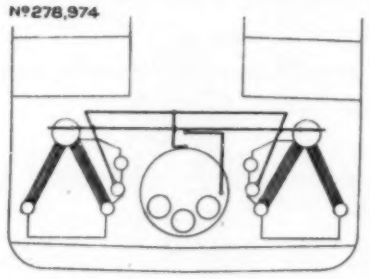
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

278,974. April 26th, 1927.—MAKE-UP WATER, J. Johnson, 10, Sheridan-road, Merton Park, Wimbledon, and P. W. Robson, Three Oaks, Horsell Common, Woking.

The inventors state that hitherto the water-tube boiler has not come into general use for mercantile marine purposes owing to the fact that it is very subject to "priming" and also to tube failures. It is known that the chief cause both of priming

Nº278,974



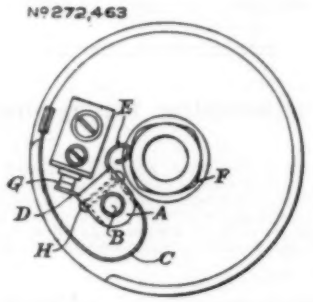
and tube failures arises from impurities in the boiler-feed water, which are difficult to prevent under the conditions of the mercantile marine service. So they employ a composite set of boilers, some of which are of the Scotch type and some water-tube, as shown in the illustration. The make-up water is fed into the Scotch boilers only, while the water-tube boilers are fed with plain condensate. On the steam side the boilers are, of course, interconnected.—*October 20th*, 1927.

INTERNAL COMBUSTION ENGINES.

272,463. May 11th, 1927.—A MAKE AND BREAK FOR THE ELECTRIC IGNITION DEVICES IN INTERNAL-COMBUSTION ENGINES, Robert Bosch Aktiengesellschaft, of 4, Militärstrasse, Stuttgart, Germany.

The bearing element A of the make and break device described in this specification consists of insulating material, and it turns

Nº272,463

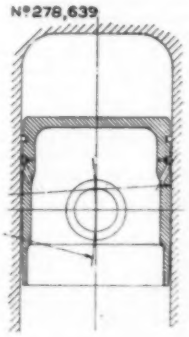


about a pin B. A spring C is attached to this member, and a contact spring is provided at D, whilst at E there is a bent spring which bears against a cam F, which serves to oscillate the make and break arm, and so operate the contact G. The three springs are secured to the block A by a common rivet H.—*October 13th*, 1927.

278,639. July 7th, 1927.—PISTONS, W. M. Dunn, 26, Meriden-street, Coventry.

The object of this invention is to reduce "piston slap." To this end the inventor so shapes the piston that its major diameter is opposite the gudgeon pin, while it tapers away with a curved

Nº278,639



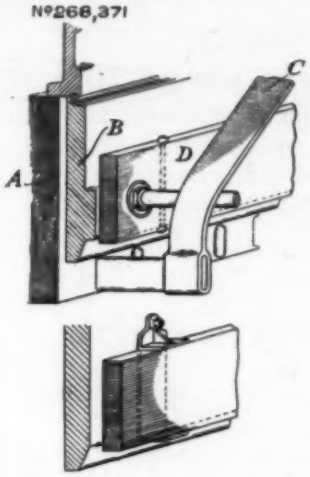
clearance both above and below. The result is that the lower edge of the skirt does not offer a shearing edge to the oil film on the cylinder wall, and there is every inducement for the oil to pass up and lubricate the bearing of the piston on the cylinder wall.—*October 13th*, 1927.

DYNAMOS AND MOTORS.

268,371. March 25th, 1927.—IMPROVEMENTS IN OR RELATING TO MEANS FOR PREVENTING EDDY CURRENT LOSSES IN MULTIPHASE ALTERNATING-CURRENT MOTORS, Allgemeine Elektricitäts-Gesellschaft, of 2-4, Friedrich Karl-Ufer, Berlin, N.W. 40, Germany.

In accordance with this invention the effective stator iron A is provided with a heavy plate cover B. Between the winding C and plate B there is a laminated part D, which prevents eddy current loss in the end plate B. This subdivided stray flux

Nº268,371



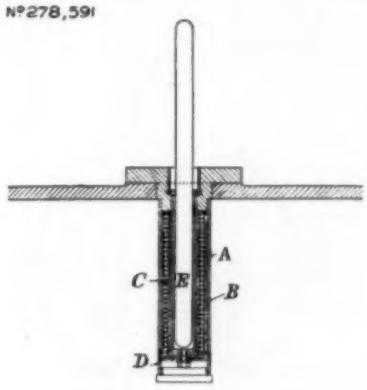
body D provides a highly conductive path for the rotating field.—*October 13th*, 1927.

TRANSFORMERS AND CONVERTERS.

278,591. March 22nd, 1927.—IMPROVEMENTS IN PROTECTIVE DEVICES FOR TRANSFORMERS, Allmänna Svenska Elektriska Aktiebolaget.

The device described in this specification may be used for indicating the temperature of a transformer or for operating

Nº278,591



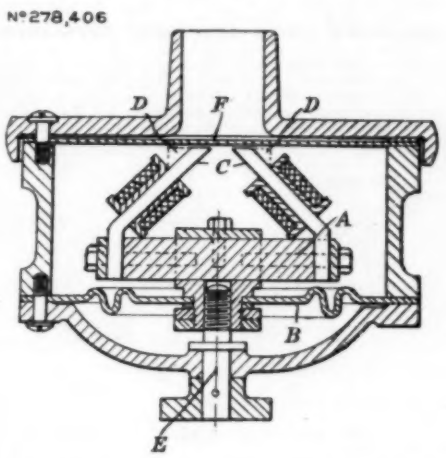
a protective device. In the cover of the transformer there is a tube A which forms an oil receptacle. Inside the tube there is an insulating lining B, composed of asbestos and a heating coil C. Another insulating layer is provided at D, and below there is an inner metal tube which contains a thermometer E or other heat indicating device.—*October 13th*, 1927.

TELEGRAPHS AND TELEPHONES.

278,406. June 9th, 1926.—IMPROVEMENTS IN OR RELATING TO LOUD-SPEAKING TELEPHONIC RECEIVERS, Sebastian Ziani de Ferranti and Ferranti, Ltd., both of Hollinwood, Lancaster.

The loud-speaking telephone described in this specification has a magnet A, composed of cobalt steel, and it is clamped to

Nº278,406



one or more flexible diaphragms B. The poles C are laminated, and are inclined as shown. Preferably the ends of the poles are enlarged as indicated by the dotted lines D. The windings are applied directly to the pole pieces. An adjusting screw E serves to regulate the position of the pole pieces in relation to the sound producing diaphragm F.—*October 10th*, 1927.

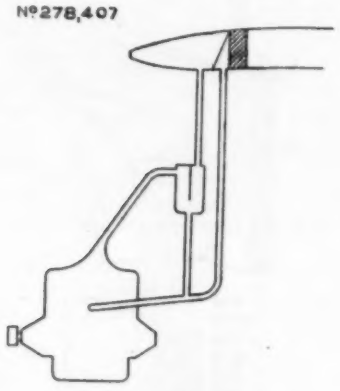
AERONAUTICS.

278,407. June 10th, 1926.—RADIATORS, T. R. Cave-Browne-Cave, Air Ministry, Kingsway, London.

According to this scheme the aeroplane engine is worked at such a temperature that the cooling jacket water boils. The steam thus generated is condensed within the wing, and the

condensate is returned to the cooling system. It is remarked in the specification that the top surface of the wing is comparatively more effective in cooling capacity than the bottom surface, whereby the advantages are gained that while the steam is cooled

No 278,407



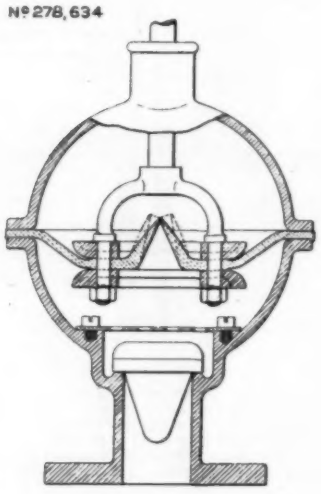
by the most effective top surface, the condensate falls to the less effective bottom surface and the tendency to over-cool or in extreme cases freeze the condensate is prevented or reduced. Further, any air which is denser than steam, tends to lie in the bottom part of the condenser.—*October 10th*, 1927.

PUMPING AND BLOWING MACHINERY.

278,634. June 23rd, 1927.—Diaphragm Pumps, H. L. Kinnersley, Delamere, Bath-avenue, Wolverhampton.

In the words of the specification:—This invention relates to pumps fitted with a diaphragm in lieu of a plunger. In such pumps the usual practice is to provide a perforation in the centre of the diaphragm and to grip it round such perforation by a fitting comprising the valve seat and the attachment to the pump

No 278,634



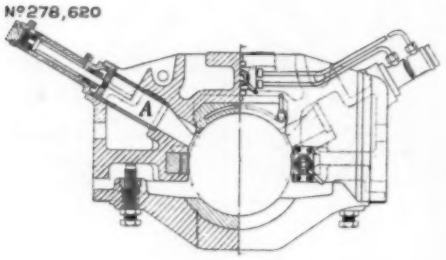
rod, the valve itself lying within a chamber in the fitting. The present invention has for its object to provide an arrangement of valve which greatly lessens the cost of the pump. According to this invention, the centre portion of the diaphragm is constituted as a valve of the flattened tube type, the valve and diaphragm being moulded together in one piece, the flattened portion of the tubular valve extending upwards from the top surface of the diaphragm.—*October 13th*, 1927.

MACHINE TOOLS AND SHOP APPLIANCES.

278,620. May 17th, 1927.—The Lubrication of Rolling Mill Bearings, D. McPhail 9, Mathieson-road, Glasgow.

This invention obviously aims at the effective lubrication of rolling mill bearings, by means of grease, but the specification leaves much to the imagination of the reader. The grease is

No 278,620



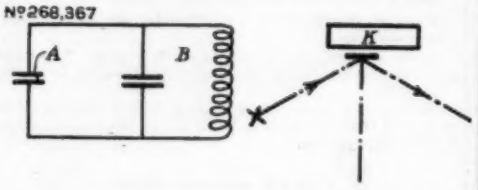
supplied by two "guns," one of which is shown in section at A. These guns are hydraulically operated in such a manner that when they are forcing the lubricant into the bearing they work comparatively slowly, but when they are being retracted, for recharging, the movement is relatively rapid.—*October 13th*, 1927.

MISCELLANEOUS.

268,367. March 24th, 1927.—Improvements in or relating to High-frequency Circuits and Indicating Arrangements Therefor, Telefunken Gesellschaft für drahtlose Telegraphie, m.b.H., 9, Tempelhofer, Ufer, Berlin, Germany.

According to this invention high-frequency electrical energy is converted directly into electrical energy. If the piezo crystal A is influenced by high-frequency oscillations from the circuit B, so that the crystal is excited at its natural period of oscillation, the air on both sides of the crystal is set into motion, and if collodium powder be strewn over the crystal it will be blown away at places. According to one scheme described in the

No 268,367

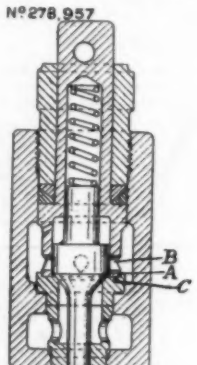


specification a mirror is placed in the path of the air current emerging from the crystal K. The mirror is therefore caused to oscillate and to control a ray of light which may be utilised to operate a mirror in any desired manner.—*October 20th*, 1927.

278,957. March 27th, 1927.—Hydraulic Valves, H. Crowe, 4, Balmoral-terrace, Saltburn-by-Sea, Yorks.

This valve is intended to minimise shocks in the piping with which it is connected. To this end the water is cut off in two

No 278,957



distinct stages. The first stage is when the lower edge of the valve A passes the ports B. These ports are made pear-shaped so as to provide a gradual closing. Subsequently the mitred face of the valve meets the seating C and makes the final closure.—*October 20th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY AND SATURDAY, NOVEMBER 26TH.

International Commercial Motor Transport Exhibition.—Olympia, London, W. 14. 10 a.m. each day.

TO-DAY.

Diesel Engine Users Association.—Caxton Hall, Westminster, London, S.W. 1. Paper, "Centrifugal Castings for Diesel Engines," by Mr. J. E. Hurst.

Institution of Civil Engineers: Birmingham and District Association.—Chamber of Commerce, New-street, Birmingham. Paper, "Hams Hall Sidings," by Mr. H. Lorain Folkes. 6 p.m.

Institution of Engineering Inspection.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Elutriation as an Aid to Engineering Inspection," by Mr. L. Andrews. 7.30 p.m.

Institution of Locomotive Engineers: Manchester Centre.—College of Technology, Sackville-street, Manchester. Lecture, "Manufacture of the Various Types of Superheaters," by Mr. R. W. Whittle. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "A Talk about Pioneers in High-Pressure Steam," by Mr. Loftus P. Perkins. 7.30 p.m.

National Institute of Industrial Psychology.—Royal Society of Arts, 18, John-street, London, W.C. 2. "How Psychology Enters into the Institute's Factory Investigations." 5.30 p.m.

Physical Society.—Imperial College of Science, South Kensington, London, S.W. 7. Papers, "On the Measurement of the Electrical Resistance of Porous Materials," by Mr. A. E. Knowler; "Regularities in the Spectrum of Ionised Neon," by Mr. P. K. Kichlu; "A Calorimeter for the Determination of the Heat Developed by Fruit," by Dr. Ezer Griffiths. 5 p.m.

West of Scotland Iron and Steel Institute.—Room 24, Royal Technical College, Glasgow. Paper, "Oil, Coal and By-products," by Mr. W. Hunter. Cinema film, "Electricity in Steel Works." 7 p.m.

MONDAY, NOVEMBER 28TH.

Bradford Engineering Society.—Technical College, Bradford. Exhibition of Films:—(1) Babcock and Wilcox Boiler; (2) The Age of Speed. 7.30 p.m.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Paper, "Military Transport Vehicles: Recent Developments and their Commercial Significance," by Captain C. H. Kuhne. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "Alloy Steels, their Manufacture, Properties and Uses," by Professor H. C. H. Carpenter. 8 p.m.

TUESDAY, NOVEMBER 29TH.

Institute of Metals: Birmingham Local Section.—The Engineers' Club, Waterloo-street, Birmingham. Paper, "Corrosion," by Dr. G. D. Bengough. 7 p.m.

Institution of Automobile Engineers.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "Motor Cycle Silencing," by Mr. C. J. E. Carter. 7.15 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, London, S.W. 1. Paper, "The Design and Construction of the Sewage Treatment Works of the City of Trenton, New Jersey, U.S.A.," by Mr. G. L. Watson. 6 p.m.

Institution of Production Engineers: Birmingham Branch.—Grand Hotel, Colmore-row, Birmingham. Paper "Efficient Production," by Mr. H. E. Taylor. 7 p.m.

North-East Coast Institution of Engineers and Shipbuilders: Middlesbrough Branch.—Cleveland Scientific and Technical Institution, Corporation-road, Middlesbrough. "The Production and Modern Application of Dissolved Acetylene," by Mr. W. C. Freeman. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "A Year's Work in X-Ray Crystal Analysis," by Sir William Bragg. 5.15 p.m.

WEDNESDAY, NOVEMBER 30TH.

Institution of Automobile Engineers.—Savoy Hotel, Strand, London, W.C. 2. Twenty-first anniversary dinner. 7 for 7.30 p.m.

Institution of Electrical Engineers: South Midland Centre.—The University, Edmund-street, Birmingham. Paper, "Battery Eliminators," by Messrs. F. R. Coursey and H. Andrewes. 7 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. Graduate Section meeting. "Boiler Performance," by Mr. B. Reed. 7.15 p.m.

Overhead Lines Association.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Discussion on "British Regulations," opened by Mr. W. Fennell. 5.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Marcellin Berthelot and Synthetic Chemistry," by Professor Henry E. Armstrong. 8 p.m.

THURSDAY, DECEMBER 1ST.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Paper, "Electric Ploughing," by Mr. R. Borlase Matthews. 6 p.m.

Institution of Mechanical Engineers: North-Western Branch.—Engineers' Club, Manchester. Annual Dinner. 6.30 for 7 p.m.

Liverpool Engineering Society: Students' Section.—The Temple, Dale-street, Liverpool. "Some Points on Electric Traction," by Mr. W. H. A. Bellis. 7 p.m.

FRIDAY, DECEMBER 2ND.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. "Cutting Tools Research Committee. Report on Cutting Temperatures: their Effect on Tools and on Materials Subjected to Work," by Mr. E. G. Herbert. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Informal meeting. Questions and discussions. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Mining Institute, Newcastle-on-Tyne. Paper, "Essential Aspects of Form and Proportions as Affecting Merchant Ship Resistance and a New Method of Estimating E.H.P.," by Mr. A. L. Ayre. 6 p.m.

TUESDAY, DECEMBER 6TH.

Institute of Marine Engineers.—85-88, The Minories, Tower Hill, London, E. 1. Lecture, "The Story of the Ship," by Sir Westcott S. Abell. 6.30 p.m.

WEDNESDAY, DECEMBER 7TH.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. Paper, "The Attenuation of Wireless Waves Over Land," by Mr. R. H. Barfield. 6 p.m.

Institution of Sanitary Engineers.—Caxton Hall, Westminster, London, S.W. 1. Paper, "The Use of Reinforced Concrete in Waterworks and Sewerage," by Mr. G. T. Cotterell. 7 p.m.

Liverpool Engineering Society.—9, The Temple, Dale-street, Liverpool. Joint meeting with the North-Western Branch of the Institution of Mechanical Engineers. Paper, "Modern Portland Cement," by Mr. Hal Gutteridge. 6 p.m.

Newcomen Society.—Institutional of Mechanical Engineers, Storey's Gate, Westminster, London, S.W. 1. Presidential address, "Making and Rolling Iron," by Mr. J. W. Hall. 5.30 p.m.

WEDNESDAY TO FRIDAY, DECEMBER 7TH TO 9TH.

Institution of Chemical Engineers.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Conference. For programme, see page 608.

FRIDAY, DECEMBER 9TH.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Informal meeting. "Economics in Engineering," by Major S. J. Thompson. 7 p.m.

Institution of Water Engineers.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Winter general meeting. "Rainfall and Flow-off, River Garry, Inverness-shire," by Captain W. N. McClean; "Underground Water Supplies, and the Need for Investigation of the Sources Thereof," by Mr. S. R. Raffety; "Failure of Slow Sand Filtration in Madras City," by Mr. J. W. Madeley. 10.30 a.m.

MONDAY, DECEMBER 12TH.

Railway Club.—25, Tothill-street, London, S.W. 1. Paper, "The Story of a Derelict Line—the Chesterford and Newmarket Railway," by Mr. K. Brown. 7.30 p.m.

The Institution of Electrical Engineers: New Honorary Member.—The Council of the Institution of Electrical Engineers has elected Mr. Thomas Alva Edison to be an honorary member of the Institution.

The Royal Aeronautical Society.—At a meeting held on November 15th, the Council of the Royal Aeronautical Society, with which is incorporated the Institution of Aeronautical Engineers, unanimously decided to elect General A. Guidoni as an honorary fellow. This is the highest distinction which the Society can confer, and every member of Council was strongly of the opinion that it would be difficult to find anyone more worthy of receiving the honour than General Guidoni, who has done so much to further the course of aviation, both in his own country and in Great Britain.